



Government of India
Ministry of Railways
(Railway Board)

Report
of the
Thirty-Seventh Meeting
of the

Locomotive Standards Committee

March 1957

Issued by Research, Design & Standardization Organisation
Chittaranjan [Dist: Burdwan]

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I—INTRODUCTION

In accordance with the Chief Design Engineer, Central Standards Office, Railway Board's Letter No. LSC/XXXVII of the 15th January 1957 to the General Manager, Indian Railways, the Locomotive Standards Committee met at Chittaranjan on 5th March 1957 and continued its work until it adjourned on 6th March 1957.

The following officers attended the meeting:—

Chairman	..	Shri J. W. E. Gurr, Chief Mechanical Engineer, Central Railway,
Member	..	" S. Chakravarti, Chief Mechanical Engineer, Southern Railway,
"	..	" M. M. Khan, Chief Mechanical Engineer, North-Eastern Railway,
"	..	" R. Krishnaswamy, Chief Mechanical Engineer, Western Railway,
"	..	" K. C. Lall, Chief Mechanical Engineer, Northern Railway,
"	..	" A. K. Mullick, Chief Mechanical Engineer, Eastern Railway,
"	..	" P. Rajnath, Chief Mechanical Engineer, South-Eastern Railway,
"	..	" C. Chalapati Rao, Dy. Chief Mechanical Engineer, Chittaranjan Loco Works,
Secretary	..	" R. Krishnamurti, Chief Design Engineer (L).

Shri R. G. Bhattawadekar, Jt. Director Research (M&C), Railway Testing & Research Centre, Chittaranjan, was present by special invitation during discussion of item No. 10.

Shri A. K. Mukherjee, Dy. Director Research (Mech.) Railway Testing & Research Centre, Alambagh, Lucknow, was present as an observer on behalf of Director, Research.



सत्यमेव जयते

II.—REPORT OF THE XXXVII MEETING OF THE LOCOMOTIVE STANDARDS COMMITTEE

A. Covering Letter from the Chairman, Locomotive Standards Committee

To

The Chief Design Engineer (L),
Central Standards Office for Railways,
Chittaranjan.

Dear Sir,

I have the honour to submit herewith the Minutes of the XXXVII Meeting of the Locomotive Standards Committee.

Yours faithfully,
J. W. E. GURR

*Chairman,
Locomotive Standards Committee.*

CHITTARANJAN;

Dated the 6th March, 57.

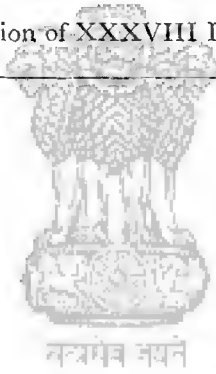




सत्यमेव जयते

B. Subject Index

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C. List of Drawings Accompanying this report.

Title of Drawing	Drawing Numbers	Last Alt : No.	Para/Item No. of this Report
Finished tyre profiles for I. R. S. Locos.	CSL 2126	3	Para 18
Condemning tyre profiles for I. R. S. Locos	CSL 2127	3	Para 18
Condemning gauge for loco tyre flanges	CSL 2222	2	Para 18
Leading and trailing solid axle box to suit 8.3/8" Dia. axle journal-WP Locos.	CSL 2495	1	Para 20
Strengthening of Front Truck axle box (Skefko) WG Locos	CSL 2580	..	Para 2(a)
	CSO Sketches		
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Types of taper ended rigid crown stay heads at fire box end .	L - 464	..	Item 4
Location of taper threaded ordinary and button headed crown stays on 8000 series "CWD" Boilers	L - 469	..	Item 4
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Tentative Diagram of Proposed 2-8-4. type tank loco	79	..	Item 6
Load Speed gradient Chart for Proposed 2-8-4. type M. G. tank Loco	LD/G 211	..	Item 6
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	I. R. Part.		
Pony truck radial arm 'WG' Locos	L/BE 667	..	Item 1

D. Report of the XXXVII Locomotive standards Committee (March 1957)

Item No. 1.

Subject	L/AB	
Description	AXLEBOX (FRONT TRUCK)	
LSC References . . . . .	..
CSO File Reference	SL/X-9/WG/Defects.	S. No.
	No. M224 RL. 74 of 4-2-56 to CSO, B.G. (CR) Railways & Secretary, Rly. Board.	(219)
	No. SL/X-9/WG/ Defects dated 15-12-56 (CSO) to the SKF Ball Bearing Co. Ltd., Calcutta.	(564)
Class of Loco Concerned	WG	
Trial No. (if any) . . . . .	..
Agenda	TO REVIEW THE PERFORMANCE OF SKF FRONT TRUCK CANNON BOXES FITTED TO WG LOCO- MOTIVES.	

Notes by Secretary The cannon type front truck axlebox castings of WG locomotives supplied by SKF have so far been generally in accordance with *Drg. No. E/SL-127/237.

The Central Railway first reported cracking of these castings, *vide* their letter No. M224 RL. 74 dated 4-2-56, and since then various railways have reported a total of 93 cases in which these steel castings have developed cracks on WG locomotives built by various Contractors in U.K. Japan and Europe.

The causes of these fractures are still under investigation by SKF. The firm have been urged to submit their final report as early as possible in order that a decision may be taken in respect of—

- (1) Preventive measures to be adopted on existing boxes which have not yet cracked,
- (2) remedial action necessary in respect of those boxes which have already cracked, and
- (3) necessary action in respect of change in design for future supplies.

A detailed note on the above points will be circulated to Railways on receipt of final recommendations from SKF.

It may also be pointed out that the Front Trucks of the 50 WG class locomotives built by M/s. Baldwins, U.S.A., on Contract No. GS-OOP/20387-T have been fitted with SKF roller bearing axle boxes in two halves bolted together and attached to the radial arm as shown in *Drgs. Nos. N 293, 40-7-2860 and 40-7-2870.

Lately, as a replacement measure, approval has been communicated to the design shown in *SKF Drg. No. 713894 for front truck roller bearing axle box in two halves and utilizing the radial arms to IR Part No. L/BE. 667 or existing radial arms altered as per CSO Sk. No. L. 274.

The Committee may review the two above-mentioned designs of roller bearing axleboxes and radial arms and indicate the Standard to be specified for future builds of WG locomotives.

Committee's Recommendation

Para 1. The Committee recommends that for future builds, cannon boxes should be in accordance with *SKF Drg. No. 713894 incorporating latest amendments suggested by the firm and approved by the Central Standards Office.

Railway Board's Orders

Para 1. *SKF drawing 714340 containing improvements over *SKF drawing 713894 is approved for future builds and replacements.

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Para 2. In respect of existing locomotives, the Committee recommends the following:—

- (a) That existing boxes which have not yet cracked should be strengthened in accordance with CSL Drawing No. 2580 (Proposal 1).
- (b) That on those boxes which have already cracked, the webs should be extended as shown in CSO Sk. L-511 after the cracks have been welded. In this connection, it is essential for the labyrinths to be checked after welding has been carried out, and if any distortion has occurred, the labyrinths to be rebored.

Para 2. (a) Approved. Railways should carry out modifications during P.O.H.

- (b) Approved methods of modifying and reinforcing the axlebox castings which are not being replaced should be worked out by R. D. S. O. in consultation with SKF, and the agreed drawings should be sent early to Railways for implementation.



REPORT OF THE XXXVII LOCOMOTIVE STANDARDS COMMITTEE
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Item No. 2

Subject	L/BE																		
Description	BOGIE, TRUCK DETAILS (CONSTANT RESISTANCE CENTERING DEVICE.)																		
LSC References																		
CSO File References	<table> <tr> <td>SL/WP/Delta.</td><td>S. No.</td></tr> <tr> <td>SL/X-9/WP of 24-8-56 (CSO)</td><td>(15)</td></tr> <tr> <td>54/1069/M of 26-8-56 (RB)</td><td>(17)</td></tr> <tr> <td>SL/WP/ Delta of 6-9-56 (CSO)</td><td>(27)</td></tr> <tr> <td>SL/WP/ Delta of 24-9-56 (CSO)</td><td>(29)</td></tr> <tr> <td>MRA/23 of 29-10-56 (RTRC)</td><td>(34)</td></tr> <tr> <td>SL/WP/ Delta of 31-10-56 (CSO)</td><td>(35)</td></tr> <tr> <td>OSG/1/MRA/23 of 10-11-56 (RTRC)</td><td>(38)</td></tr> <tr> <td>SL/WP/Delta of 15-11-56 (CSO)</td><td>(39)</td></tr> </table>	SL/WP/Delta.	S. No.	SL/X-9/WP of 24-8-56 (CSO)	(15)	54/1069/M of 26-8-56 (RB)	(17)	SL/WP/ Delta of 6-9-56 (CSO)	(27)	SL/WP/ Delta of 24-9-56 (CSO)	(29)	MRA/23 of 29-10-56 (RTRC)	(34)	SL/WP/ Delta of 31-10-56 (CSO)	(35)	OSG/1/MRA/23 of 10-11-56 (RTRC)	(38)	SL/WP/Delta of 15-11-56 (CSO)	(39)
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SL/WP/ Delta of 31-10-56 (CSO)	(35)																		
OSG/1/MRA/23 of 10-11-56 (RTRC)	(38)																		
SL/WP/Delta of 15-11-56 (CSO)	(39)																		
Class of loco Concerned	WP																		
Trial No. (if any)																		
Agenda	TO REVIEW THE RESEARCH REPORT OF OSCILLATION TRIALS ON WP LOCOMOTIVES FITTED WITH CONSTANT RESISTANCE CENTERING DEVICE.																		

Notes by Secretary Nine of the 120 new WP locomotives recently obtained from Canada on Contract No. 120/CP/WP/L have been fitted with the Constant Resistance Centering Device, as follows:—

- | | |
|-------------------|---|
| 3 locos | Device fitted on engine bogie and hind truck; |
| 3 locos | Device fitted on engine bogie only ; and |
| 3 locos | Device fitted on hind truck only. |

Trials are in progress with these locomotives and the report prepared by Research Directorate will be circulated to Railways, for consideration at the Meeting.

Committee's Recommendation

Para 3. The Committee notes that the initial trials with the bogie indicate the necessity for some modification in the design to reduce the flange forces on 1 in 8 1/2 turnouts. To enable a decision to be reached regarding the design to be adopted on future builds, the matter should be followed up by correspondence.

Para 4. The Committee also notes that difficulty has been experienced by both the Eastern and Northern Railways with this device fitted to the hind truck, and that the Central Standards Office is issuing a directive in this connection.

Railway Board's Orders

Para 3. Noted. R. D. S. O. to take necessary action.

Para 4. Noted. R.D.S.O. to take necessary action.

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Item No. 3

Subject L/BG

Description BRAKE GEAR DETAILS, ETC.

LSC References XXVI/App. II-Item 63, XXXV-8.

CSO File Reference SL/L/BG. S. No.

No. SL/L/BG of 22-11-55 to Railways and (CSO) (147)
replies thereto.

Class of loco concerned IRS Locos.

Trial No. (if any)

**Agenda TO CONSIDER THE STANDARDIZATION OF THE
COMPOSITE DESIGN OF CAST IRON BRAKE SHOE
WITH CAST STEEL BRAKE HEAD.**

Notes by Secretary The composite design of brake block with cast iron brake shoe and cast steel brake head was accepted as a standard by the XXVI L.S.C. meeting, but was superseded by the cast iron solid brake block, *vide* para 8 of the minutes of the XXXV L.S.C. meeting. This decision was based on the general opinion of Railways that the composite design was more difficult to manufacture.

Railways were subsequently asked to review the above decision at the instance of C.M.E./C.L.W., and replies indicate that opinion is divided on the subject.

The Committee may review its previous decision in the light of views now expressed by Railways, and indicate whether the standard is to be changed.

Committee's Recommendation

Para 5. In view of the difficulty in manufacturing/procuring composite brake blocks, the Committee recommends that solid cast iron brake blocks should be retained/adopted as standard. As a result of the decision taken at the XXXV loco. Standards Committee Meeting, cast iron blocks have already been standardized on Locomotives, but in respect of tenders, this entails a modification in the design of the brake gear. The R. D. S. O. should be asked to prepare suitable designs for the introduction of cast iron blocks on both Broad and Metre Gauge standard locos.

Railway Board's Orders

Para 5. The solid cast iron brake block should be standard for the engines and for tenders to the extent possible on existing types of steam locomotives.

On future designs, solid cast iron brake blocks should be adopted exclusively for engines and tenders of steam locomotives.

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Item No. 4

Subject L/FX

Description FIREBOX (STAYS)

LSC References

	} SL/WP/V No. SL/WP/V of 3-5-48 & replies thereto . (CSO) IL/CWD/FXS. No. IL/CWD/FXS of 21-4-55 and replies thereto. (CSO) No. M142 RL. 3 of 6-9-56 & comments from other Railways. (CR)	S. No.
CSO File Reference		(7)
		(98)
		(129)

Class of loco concerned All

Trial No. (if any)

Agenda TO CONSIDER THE APPLICATION OF "BUTTON-HEADED" CROWN STAYS ON STEEL FIREBOXES.

Notes by Secretary CWD Engine No. 5513 of the Ex-Nizam State Railway suffered a collapsed crown due to shortage of water in 1951. A similar case has recently occurred on Loco No. 5765 AWD of the Central Railway, resulting in fatal injuries to the crew.

The 5000-7000 series of A/CWD boilers were fitted with 8 longitudinal rows of ordinary taper thread crown stays with small heads, as shown in Fig. A of CSO Sketch L-464, whereas the 8000 series CWD boilers obtained later on are provided with 72 "button-headed" crown stays in 9 transverse rows of 8 stays, in banks of 3 rows each as shown in CSO Sketch L-469.

On a reference from the then Technical Adviser to India Supply Mission, Washington, the question of fitting "button-headed" crown stays in WP boilers was referred to Railways, vide CSO letter No. SL/WP/V dated 3-5-48. Based on the experience of Railways, and tests carried out in India and the U.S.A., which led to the conclusion that a fully formed head was quite adequate in respect of strength, and that the provision of a large number of "button-headed" stays could result in severer damage in case either the stay or the plate gave way, due to increased rigidity, the Technical Adviser was informed that the Indian Railways preferred to adhere to the ordinary design of taper stays having a taper of 1 in 6, with a head fully formed out of 3.5 to 4.0 threads.

It is observed that the stay heads shown in the drawings of 5000-7000 series WD loco boilers have not been properly formed—the diameter and depth being inadequate to present sufficient shear area to resist the tendency to collapse.

While there is little doubt that a properly fitted 'button-headed' stay provides more staying strength to the crown sheet, as compared with a taper stay with a fully formed head (Fig. C of CSO Sketch L-464), it is necessary to take into consideration the increased cost of material and labour for manufacture and fitting of such 'button-headed' stays.

The Committee may consider the relative merits of 'button-headed' and ordinary taper stays with fully formed heads, and express its views on whether—

- (a) All steel fireboxes not having thermic syphons should be fitted with adequate number of 'button-headed' crown stays during firebox renewal.

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- (b) As an immediate safety measure, all steel fireboxes not having thermic syphons should be fitted with a few 'button-headed' stays as boilers pass through shops, and
- (c) All future builds of steel firebox boilers not fitted with thermic syphons should be fitted with adequate number of 'button-headed' stays.

In the case of boilers fitted with thermic syphon, it is felt that the thermic syphon itself provide considerable support to the crown sheet, and as such 'button-headed' crown stays would not be necessary.

Committee's Recommendation

Para 6. The Committee considers that, provided the knobbled over stay heads are properly formed, there is no necessity for the introduction of button-headed stays. The Committee, therefore, recommends that the existing practice should continue as standard.

Railway Board's Orders

Para 6. Approved. Existing practice should continue.



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Item No. 5

Subject L/GEN

Description CRANES

LSC References

CSO File Reference SL/CRANES

S. No.

Noting dated 28-9-56 (JDME) p. 37/n.

Class of loco concerned

Trial No. (if any)

Agenda TO STUDY THE RELATIVE MERITS OF STEAM AND DIESEL CRANES, AND TO ADOPT SUITABLE STANDARDS.

Notes by Secretary At appendix I is a note detailing the merits of Steam and Diesel powered Breakdown and Transportation cranes. The Steam Cranes standardised since 1951 are shown in *CSO Sketches 5120 and 5121.

The Committee may consider the above note, and express its views on the acceptability of Diesel-powered cranes for particular duties.

Committee's Recommendation

Para 7. (a) For rail-mounted Transportation and commercial services (*i.e.*, from 5 to 20 tons capacity), the committee recommends that, before adopting Diesel-powered cranes as standard, proto-type cranes should be tried out on each Railway to determine the maintenance facilities required and to assess the efficiency of their performance. The performance capabilities of the diesel cranes should be similar to those of the steam cranes. Before the specification is finalised, the Committee recommends that the permissible axle load should be reviewed with the object of increasing this to the maximum acceptable.

(b) For Breakdown services, the Committee recommends that the adoption of Diesel-powered cranes should be deferred until experience has been gained with similar cranes purchased for Transportation and Commercial services.

(c) For Coaling purposes, the Committee recommends that steam-powered cranes should continue to be used.

Railway Board's Orders

Para 7. (a) Noted. In the next order for 5-ton rail travelling cranes, a limited number of diesel-powered cranes should be obtained and allotted to one particular railway. R.D.S.O should follow up their performance in service during the next two years and submit a report for consideration of the Board.

R. D. S. O. should review the permissible axleloads and revise the standard designs of cranes accordingly.

(b) Approved.

(c) Approved.

* Not printed in this Report.

REPORT OF THE XXXVII LOCOMOTIVE STANDARDS COMMITTEE
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Item No. 6

Subject L/GEN

Description DESIGNS

LSC References

CSO File Reference	$\left. \begin{array}{l} SL/MISC/XII \\ SL/Misc/XII \text{ of } 23-11-55 \text{ and replies thereto} \\ D.O. RA/LSC \text{ of } 12-12-56 \end{array} \right\}$	(CSO) (299) (RA) (390)	S. No. (299) (390)
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Class of loco concerned Metre Gauge.

Trial No. (if any)

**Agenda TO DECIDE ON THE TYPES OF METRE GAUGE
STANDARD STEAM LOCOMOTIVES IN THE LIGHT
OF INVESTIGATIONS MADE BY RAILWAYS AND CSO.**

Notes by Secretary A statement is attached at Appendix II showing by types the requirements of metre gauge steam locomotives, as proposed by Railways, and as estimated by RDSO after analysis of the loads, speeds, gradients, etc., furnished by Railways on the RDSO questionnaire. This statement excludes the requirements of locomotives for the Saurashtra region of the Western Railway where large-scale dieselisation is envisaged, and for which the Railway has estimated a total of 310 Diesel locomotives. Should the proposal to dieselise this section not materialise, the requirements of steam locomotives will have to be correspondingly increased.

The statement is divided in two parts :—

- (a) For existing services, and
- (b) For services envisaged at the end of the next 5 years.

The following remarks are offered on the present and proposed types of standard locomotives.—

- (1) *YP*.—This class of locomotive will continue to remain a standard for most passenger services. A sizeable proportion of the services previously envisaged for the YL class locomotives will now have to be taken over by the YP locomotives in view of increased loads and speeds.
- (2) *4-8-2 Heavy Passenger Tender Locomotive*.—Detailed analysis of the service requirements at the end of the Second Five Year Plan indicates the need for 80 Nos. of a heavy passenger locomotive capable of hauling loads as shown in Appendix III. CSO Sketch LD/SK-76 shows this locomotive in outline, and its estimated performance characteristics are shown in Graph LD/G-212.
- (3) *YL*.—The YL class locomotive with an axleload of 8.0 tons was envisaged as the standard locomotive for light passenger services up to a limit of 10 bogies. Previous estimates showed that a large number of these locomotives would be required and accordingly orders were placed in 1953 for the purchase of 254 such locomotives. A study of the requirements for the anticipated traffic subsequent to the Second Five Year Plan, however, reveals that a number of services previously expected to be handled by this class of locomotive will now be beyond its capacity. For such services, the YP class locomotive will have to be used. According to R.D.S.O. estimates, it is anticipated that not more than 89 YL class locomotives will be required, if the increased traffic materialises.

The YL class locomotives, which would thus be rendered surplus, could be utilised on services for which the YM has been proposed.

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- (4) *YM*.—This 2-6-4 tank locomotive with a 9.0 ton axleload was envisaged for shuttle services and for shunting and banking duties. According to estimates for existing services, there is a considerable demand for this class of locomotive, and 12 proto-type locomotives have been ordered from Japan. The increase in loads anticipated at the end of the Second Five Year Plan will, however, limit the use of such a locomotive and, according to RDSO estimates, not more than 89 Nos. will be required. Even these services could be handled with the surplus YL locomotives referred to in para 2 (3) above. There would thus appear to be no further justification for proceeding with any large-scale purchase of this class of locomotive.

Some of the services previously envisaged for the YM class locomotive would be beyond the capacity of either the YM or the YL class locomotive. For this purpose, a more powerful 2-8-4 type tank locomotive with a 10½-ton axleload is necessary, and this is discussed below.

- (5) *YS*.—This 2-10-6 tank locomotive, which was envisaged as a heavy goods shunter, is not required either for existing services or for the anticipated traffic according to the revised R.D.S.O. estimates. The heavy goods shunting, which was envisaged for this locomotive, can be easily dealt with by the 2-8-4 tank locomotive referred to earlier. There appears, therefore, no need to proceed with the development of this design.
- (6) *YG*.—This locomotive, developed as the standard goods unit, will continue to be required in large numbers. Some of the services, however, will be beyond its capacity and a more powerful goods locomotive will have to be considered for such services.
- (7) *Heavy Goods Locomotive*.—The 10.5 ton axleload 2-8-2 YG class locomotive, not being adequate for certain goods services in Western, North-Eastern and Southern Railways, necessitates consideration of a more powerful unit. Such a Heavy Goods Locomotive, which will be required to exert a starting pull of 33000 lbs., cannot be designed as a conventional steam locomotive with 10.5 ton axleload. These services can, therefore, be met with only by one of the following three alternatives:
- (a) Double-headed YG locomotives (with reinforced tender underframes),
 - (b) Articulated steam locomotives, or
 - (c) General Purpose Diesel locomotives.

In case a general purpose diesel locomotive is to be adopted for this service, the same locomotive can also be utilised for the heavy passenger services referred to in para 2 (2) above. Preliminary estimates indicate that approximately 2200 HP would be required to cater for such services, which can be provided by two 1100 HP units operating in multiple.

- (8) *2-8-4 Tank Locomotive*.—As already mentioned, some of the shuttle and shunting services previously envisaged for YM class locomotive will be beyond the capacity of that unit. A more powerful 2-8-4 type tank locomotive with a 10½-ton axleload, and haulage capacities as shown in Appendix, IV will be necessary for meeting these requirements. Since this locomotive will also be able to deal with the services envisaged for the YS class locomotive, the YS class can be eliminated from the list of standard units and replaced by the new 2-8-4 tank unit. CSO Sketch LD/SK-79 shows the locomotive in outline, and Graph No. LD/G-211 shows the estimated performance characteristics of this locomotive.

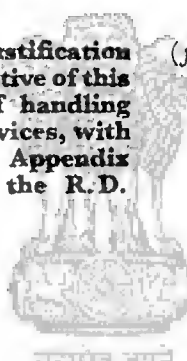
The Committee may review the needs of the different types of steam locomotives in the light of the above comments, keeping in view the future policy of dieselisation on different sections of Indian Railways, and indicate which types of steam locomotives should be standardized.

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Committee's Recommendation

Para 8. The Committee reviewed the needs for different types of steam locomotives and based on the operative requirements furnished by Railways to the R. D. S. O., recommends the following:—

- (a) YP.—This locomotive should continue to remain a standard for Passenger service.
- (b) YG.—This locomotive should continue to remain a standard for Goods service.
- (c) YL & YM.—These types should continue as standard locomotives.
- (d) 4-8-2 Heavy Passenger Loco.—There is justification for the introduction of a locomotive of this type with the performance indicated in the Appendix III, prepared by the R. D. S. O.
- (e) Heavy Goods Loco.—There is a clear demand for a more powerful locomotive than the YG. This can best be met by the introduction a general purpose Diesel locomotive of approximately 1100 B. H. P.
- (f) 2-8-4 Tank Loco.—There is a justification for the introduction of a locomotive of this type which should be capable of handling shuttle as well as shunting services, with a performance as indicated in Appendix "IV" of the Agenda prepared by the R. D. S. O.



Para 9. The Committee recommends that the 4-8-2 Heavy Passenger locomotive should be fitted with roller bearing axleboxes on the coupled as well as carrying axles.

Railway Board's Orders

Para 8. (a), (b), (c), YP, YG, YL & YM class locomotives should remain as Standard types for the Metre Gauge.

- (d) A new 4-8-2 heavy passenger steam locomotive with 10.5 tons axleload is approved as a standard for the Metre Gauge. R.D.S.O. to undertake preparation of detailed drawings for indigenous manufacture.
- (e) The introduction of a general purpose Metre Gauge 1100 HP Diesel locomotive is approved. The adoption of a heavy goods steam locomotive as a standard type should be deferred.
- (f) The introduction of a 2-8-4 Tank steam locomotive of a standard for the Metre Gauge is approved. R. D. S. O. to undertake the preparation of detailed drawings for indigenous manufacture.

R.D.S.O. will give priority in detailing work to the 2-8-4 Tank Steam Locomotive for which the prospective demand is larger than for the 4-8-2 heavy passenger.

Para 9. Approved.

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(MARCH 1957)**

Item No. 7

Subject L/GEN

Description SHUNTING LOCOMOTIVE (Diesel).

LSC References

CSO File Reference	{	SL/WDS	S. No.
		No. 494-M/246 (M.VII) of 17/21-8-56 (NR)	(56)
		No. M. 381. RL. 18 of 19-9-56 (CR)	(88)
		SL/DIESEL/BG	
		No. 56/466/12/M of 31-8-56 (RB)	(228)
		No. SL/Diesel/BG of 15/17-9-56 to A.M.M. (CSO)	(229)
		and copy to W. Rly.	

Class of loco concerned

Trial No. (if any)

**Agenda TO DECIDE ON THE HORSE-POWER FOR STANDARD
BROAD GAUGE DIESEL SHUNTING LOCOMOTIVES.**

Notes by Secretary The 30 WDS 0-6-0 Broad Gauge Shunting locomotives with a 17-ton axleload recently obtained from Germany have a 440 BHP (nominal) engine. With an average factor of adhesion of 4, this locomotive is capable of developing a steady tractive effort, at low speeds, of 28,500 lbs. and can start the following loads on various gradients :—

Grade	Starting load
	tons
1 in 100	660
1 in 150	790
1 in 200	890
1 in 250	950
1 in 300	1020
1 in 400	1090
1 in 500	1150

The acceleration of this locomotive is, however, low and has been reported adversely by Railways. A single WDS locomotive delivering 274 rail horse-power is capable of the following acceleration to a speed of 10 MPH:—

1200 T		1800 T		2300 T	
Time (minute)	Distance (miles)	Time (minute)	Distance (miles)	Time (minute)	Distance (miles)
1.85	0.20	3.55	0.39	4.99	0.548

Thus, while the starting effort of the locomotive is adequate, the horse-power needs to be increased so as to improve the the acceleration for heavy goods shunting services.

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A sample analysis of the working in a large goods yard was recently carried out to determine the extent to which a single WDS locomotive of 400 HP would be able to meet traffic requirements. The stiffest gradient in this yard is 1 in 100 up, leading into a shunting neck which can accommodate 20 Broad Gauge wagons. At present all shunting services are being performed by 0-6-4T saturated steam locomotives having a nominal tractive effort of 21023 lbs. at 85% boiler pressure. The study reveals that the 400 HP WDS locomotive can meet all other requirements except 6 transfer movements during 24 hours when loads of approximately 1900 tons have to be transferred over a 1 in 200 up transfer line. For this purpose dual-coupled WDS locomotives would be necessary and they would be able to achieve a speed of approximately 9 m.p.h. when hauling this load.

If higher horse-power locomotives were to be utilised for all shunting work in this yard, instead of the alternatives of dual-coupled operation with WDS locomotive, the larger units would work uneconomically for nearly 85% of the total period they are in commission.

In estimating the Diesel power requirements for shunting service, therefore, it is necessary to take into account the load factor of the heavier units in a goods yard.

A review of the shunting service requirements based on the replies from Railways to the CSO questionnaire issued in 1954, which was considered at the XXXV L.S.C. meeting indicates that a complete changeover to Diesel traction for passenger and goods shunting services on the Broad Gauge would involve a total of about 1000 locomotives of which about 500 units need to be of 400 H.P., if uneconomical operation with higher powered units is to be avoided. For the balance, it is estimated that a 600 HP locomotive will be the most suitable unit of which nearly 50% will be used dual-coupled for hump yard and extra heavy goods shunting requirements. The increase in horse-power is mainly to meet the needs of adequate acceleration, which, for a single 600 BHP locomotive, would be approximately as follows for attaining a speed of 10 MPH.—

1200 T		1800 T		2300 T	
Time (minute)	Distance (miles)	Time (minute)	Distance (miles)	Time (minute)	Distance (miles)
0.994	0.092	1.78	0.15	2.62	0.20

The Committee may consider the above comments and express their views on the choice of future standard Broad Gauge Shunting locomotives.

Committee's Recommendation

Para 10. The Committee recommends that 400 HP and 600 HP units should be standardized for BG Diesel Shunting locomotives. Should experience indicate, the need for the introduction of a higher power locomotive may have to be considered.

Railway Board's Orders

Para 10. Approved. The need for the introduction of higher horse-power shunting locomotives should be considered at a future LSC meeting on review of the performance of the 600 HP units.

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Item No. 8

Subject L/GEN

Description MODIFICATIONS TO LOCOMOTIVES.

LSC References XXIX-106.

CSO File Reference	} SL/MOD SL/Mod dated 23-11-56 to all Railways, (CSO) DME/Rly. Board, CME/CLW.	S. No. (45)

Class of loco concerned I.R.S.

Trial No. (if any)

Agenda TO RECORD THE LIST OF PERMISSIBLE ALTERNATIVES RELATING TO STANDARD LOCOMOTIVES.

Notes by Secretary A list of permissible alternatives revised up-to-date is given at appendix V which the Committee may note and record.

In order to facilitate work in the RDSO, the method of recording and numbering of modifications has also been revised. A consolidated list of such modifications is being circulated separately to Railways. The Committee may note this list.

Committee's Recommendation

Paras 11 & 12. The Committee records the list of Permissible alternatives, but recommends the alterations indicated in appendix V.

Para 13. The Committee noted the list of approved modifications for IRS locomotives prepared by the R. D. S. O.

Railway Board's Orders

Paras 11 & 12. See Appendix V for Railway Board's Orders.

Para 13. Noted.

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Item No. 9

Subject L/GEN

Description STEEL CASTINGS

LSC References

CSO File Reference *SL/GENL/VI* S. No.
No. SL/YP/IM of 26-9-56 and reply thereto (CSO) (42)

Class of loco concerned WP, WG, YP, YG.

Trial No. (if any)

**Agenda TO CONSIDER THE ADOPTION OF FABRICATED
DESIGN OF COMPONENTS IN LIEU OF STEEL
CASTINGS FOR STANDARD LOCOMOTIVES.**

Notes by Secretary In view of the extreme shortage of indigenous capacity for the production of steel castings in good quality, both C.L.W. and TELCO find it necessary, at times, to adopt alternative fabricated designs for such components, with a view to avoiding serious production hold-ups. Particulars of important components are as appended below.

It is pointed out that proper quality control, heat-treatment, metallurgical tests and X-ray examinations (wherever possible) are being enforced.

The Committee may approve the principle of adopting fabricated components in lieu of steel castings, as an emergency measure.

Sl. No.	Description.	Class of Locos.	*Drawing No.	Ref. let.
1	2	3	4	5
1	Frame Stay (Engine)	WG	I.R.Part No. L/FR-604	
2	Front Drag Casting (Engine)	WG	E/SL-127/142	A
3	Reversing Screw Braket support	WG	E/SL/12/200	B
4	Motion Girder	WG	E/SL/127/147	A & B
5	Cross Head	WG	E/SL 127/188	A & B
6	Spring Saddle	WG	L/SL 127/254	A
7	Tender Front Drag Casting	WG	E/ST 177/11	A
8	Valve Motion Bearer	YG	E/SL 217/175	D
9	Slide Bar Guide Bearer	YG	E/SL 217/169	C
10	Pedestal Crosstie	YG	E/SL 217/152	D
11	Guide Bearer Crosstie	YG & YP	{ E/SL 217/151 (YG) E/SL 216/142 (YP)	F A
12	Frame Filling	YG & YP	{ E/SL 217/148 (YG) E/SL 216/138 (YP)	A A
13	Reversing shaft Bearing support	YG	E/SL 217/178	V
14	Engine Truck Frame	YG	E/SL 217/264	A
15	Front Truck Radius Bar	YG	E/SL 217/265	A

* Not printed in this Report

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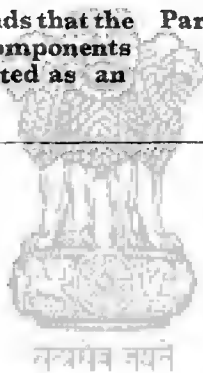
1	2	3	4	5
16	Hind Drag Casting	YG & YP	{ E/ST 276/18 (YG) 2 YP/143 (YP)	A Item 1
17	Hind Truck Adjusting Spring Rod Bracket	YG	E/SL 217/269	T
18	Brake Shaft Crosstie	YP	E/SL 216/142	B & E
19	Valve Motion Bearer Crosstie .	YP	E/SL 216/141	A
20	Front Truck Crosstie	YP	2 YP/222	Item 1
21	Boiler Support and Hind Truck Fulcrum	YP	2 YP/145	Item 1
22	Driving Box saddle	YP	E/SL 216/207	A
23	Trailer Truck Box	YP	E/SL 216/193	A
24	Engine Truck Bolster	YP	E/SL 216/239	A

Committee's Recommendation

Railway Board's Orders

Para 14. The Committee recommends that the principle of adopting fabricated components in lieu of steel castings may be accepted as an emergency measure.

Para 14. Approved.



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Item No. 10.

Subject L/PX

Description CROSSHEAD—GUDGEON PIN.

LSC Reference XXII-82

		SL/WP/CH	S. No.
CSO File Reference	}	No. 494. M/6/61 (M7) of 21-8-56	(NR) (463)
		No. MD/L/PX of 30-10-56	(ER) (469)
		No. 2498/48091 of 16-11-56	(SER) (471)
		No. M. 110/1/5 of 3-12-56	(WR) (473)
		No. SL/WP/CH of 31-12-56	(CSO) (478)

Class of loco concerned WP

Trial No. (if any)

Agenda TO REVIEW THE FAILURE OF WP LOCOMOTIVE GUDGEON PINS.

Notes by Secretary Railways have reported a number of cases in which WP locomotive gudgeon pins have fractured through the grease out-feed holes. In accordance with Railway Board's orders on para 82 of the XXII L.S.C. meeting, these gudgeon pins are made of Class I steel, case hardened.

A review of the stress concentrations due to the presence of the grease out-feed holes—based on recent studies made abroad reveals that the fibre stress around the grease hole edge exceeds the safe working limit for Class I steel.

With a view to studying the effect of relieving grooves machined at suitable distances from the hole periphery, the Research Directorate has been requested to carry out a photo-elastic study of this problem. The results of this study will be tabled at the meeting.

The Committee may consider the adoption of the following remedial measures:—

A. For new manufacture:

- (i) The class of material should be altered from M.3 Cl.I to M. 26 Cl. XI.
- (ii) The number of grease out-feed holes to be reduced from 3 to 2. These two holes to be in the vertical plane but not diametrically opposite. Shifting of the grease holes from the existing positions to the vertical plane will reduce stress concentration, as this is the plane of least stress.
- (iii) Relieving grooves to be provided on either side of the out-feed holes as shown in CSO Sketch L-474 Fig. 2. The exact size and location of these grooves to be determined on the basis of the photo-elastic study referred to above.
- (iv) Railways to ensure maintenance of the chamfer provided at the end of the out-feed holes.

B. Existing pins:

- (i) Provide stress relieving grooves on either side of the out-feed hole as shown in CSO Sketch L-474 Fig. 1. The exact size and location of the grooves to be based on the results of photo-elastic study.
- (ii) Periodical inspection of gudgeon pins with a view to withdrawing those from service, which may show signs of crack development around the grease hole edges.
- (iii) Railways to ensure maintenance of the chamfer provided at the end of the out-feed holes.

Committee's Recommendation

Para 15. The Committee recommends that gudgeon pins should be manufactured from Class I steel and case-hardened on the wearing surface. They should also be case-carburised inside the grease cavity. Care should, however, be taken that the inside surface is not decarburised subsequent operations. The Railway Testing & Research Centre, Chittaranjan, should be asked to apprise Railways of the procedure for the correct heat treatment of these pins.

Para 16. If Class I steel is not available, Class IV steel may be used. In this case, however, efforts should be made to flame-harden the wearing surface.

Railway Board's Orders

Paras 15 & 16. Gudgeon pins should be manufactured in steel Class IV and flame-hardened on the wearing surface in terms of the 8th IRCM's recommendation against item 21 of their recent meeting.

Where the practice of flame-hardening cannot be observed, the gudgeon pins may be manufactured in Steel Class I and the wearing surface case-hardened. They should also be case-carburised inside the grease cavity. Care, should however, be taken that the inside surface is not decarburised in subsequent operations. The Railway Testing & Research Centre, Chittaranjan, should be asked to apprise Railways of the procedure for the correct heat treatment of these pins.

Para 17. With both classes of steel the size of the bore should be reduced to $3/4"$.

Para 17. Approved. R. D. S. O. to revise part drawings accordingly.



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Item No. 11.

Subject L/TY

Description TYRE PROFILES & PROFILE GAUGES.

LSC References XXIX-65, XXX-68, XXXII-51—53, XXXIII-40-41.

CSO File Reference SL/TYR.

Class of loco concerned All.

Trial No. (if any) Nil.

Agenda TO APPROVE AND RECORD CSL DRAWINGS NOS. 2126, 2127 & 2222 RELATING TO TYRE PROFILES AND PROFILE GAUGES.

Notes by Secretary The Railway Board in their orders on paras 40 & 41 of the Minutes of the XXXIII L.S.C. Meeting accepted the Committee's recommendations, and desired that CSO should issue drawings showing condemning tyre profiles including root and tread-wear and to evolve a suitable design of tyre profile condemning gauge.

The Committee may study the following drawings and recommend their adoption by Railways:—

CSL 2126—Showing new tyre profiles.

CSL 2127—Showing condemning tyre profiles.

CSL 2222—Showing a condemning gauge for Loco tyre flanges.

In respect of the Tyre Flange condemning gauge, it may be pointed out that there is no serious objection to individual Railways adopting alternative designs, provided the following essentials are ensured:—

- (1) The gauge or gauges should check the flange thicknesses at two points. The position of these two points are indicated in CSL Drg. 2127 with reference to the outermost edge of the unworn flange.
- (2) The gauges should show the profile as condemned if these measured thicknesses are equal to or less than the thicknesses of the condemning profile given in CSL Drg. 2127 at these positions.

In this connection it is observed that Railways have expressed a preference for the adoption of type flange profiles intermediate between new and condemning, with a view to conserving tyre material. There appears no objection to individual Railways adopting any such intermediate profiles provided these profiles lie within the limitations imposed by the new and condemning profiles.

Committee's Recommendation

Para 18. The Committee recommends the following:

- (a) CSL Drg. 2126 Alt. 3 may be recorded.
- (b) CSL Drg. 2127 Alt. 2 may be approved.
- (c) The condemning gauge shown in CSL Drg. 2222 Alt. 2 may be accepted.

Para 19. In order to conserve material the Committee recommends that the R. D. S. O. should evolve an intermediate profile for issue to Railways.

Railway Board's Orders

Para 18. (a), (b) & (c)—Approved.

Para 19. R. D. S. O. to take necessary action.

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Item No. 12

Subject	L/WL L/AB	
Description	WHEELS AND AXLES.	
LSC References	XXIX-67, XXXV-76, XXXVI-40	
CSO File Reference.	<div style="display: inline-block; vertical-align: middle;"> SL/WP/WA No. 54/731/11/M of 11-3-55 SL/WP/AB No. SL/WP/AB of 20-4-56 to CME/ Eastern Rly. & other Railways and replies thereto. SL/AB/Isothermos 14/2/JO/6639, DBM of 19-9-56 (Appendix 'C') </div> <div style="display: inline-block; vertical-align: middle; margin-left: 20px;"> (RB) (CSO) (Heatly & Gresham) </div> <div style="display: inline-block; vertical-align: middle; margin-left: 20px;"> S.No (250) (494) (35) </div>	
Class of loco concerned	WP.	
Trial No. (if any). . . . .	..
Agenda	TO REVIEW THE FAILURE OF COUPLED AXLES ON WP LOCOMOTIVES AND RECOMMEND TRIALS WITH 'ATHEROMS' AXLEBOXES.	

Notes by Secretary The failures on WP coupled axles were reviewed at the XXXVI L.S.C. Meeting. Since then there have been further reports by railways involving 8 axles during 1956, bringing the total to 87.

The XXXVI L.S.C. recommended increasing the diameter of the leading and trailing coupled axles and the adoption of roller bearings on all future builds of WP locomotives. The 60 WP locomotives currently under manufacture in Europe are being fitted with Timken roller bearings in cannon axlebox housings.

The Research Directorate has since conducted bearing temperature trials on WP locomotives and the report will be circulated to Railways by Director, Research.

C.M.E./ Central Railway has also recommended the adoption of cast in horizontal grease grooves for the coupled axleboxes of WP locomotives. In this connection, attention is invited to para 67 of the XXIX L.S.C. Report wherein it was decided that grease grooves should be in accordance with *LSC Drg. No. 348 only. The elimination of horizontal grease grooves was decided upon as a result of failures of solid bronze coupled axleboxes on XD (IGR) locomotives provided with machined horizontal grease grooves. Similar trouble was also reported on WP locomotives. CME/Central Railway has, however, advised that trials with cast in horizontal grease grooves have given satisfactory results on WP locos.

The Committee may review the failure of WP coupled axles during the past year, and the adoption of remedial measures suggested by the Research Directorate in respect of running shed maintenance etc. The Committee may also consider the following additional proposals.—

- (i) *Trials with 'Athermos' axleboxes on WP locomotives.*

The makers of this type of axlebox claim the following advantages for this type of axlebox.—

- (a) A robust and simple design of components ensures long and satisfactory life of journals and bearings,
- (b) All routine repairs can be undertaken in running sheds by the fitting staff,

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- (c) The special design of oil seals prevents the ingress of any foreign matter into the axlebox housing,
- (d) The possibility of early manufacture in India, and
- (e) The box can be designed to suit Railways' requirement in respect of interchangeability with other types in the same locomotive frame.

In this connection the Committee's attention is invited to Board's orders on paras 49-51 of the XXXV Carriage & Wagon Standards Committee Report.

(ii) *Provision on horizontal grease grooves on the plain bearing axleboxes of existing WP locomotives*

Committee's Recommendation

Para 20. The Committee reviewed the lubrication arrangements shown in CSL Drawing 2495 Alt. 1 and CSO Sketch L 514. The Central Railway reported satisfactory results with the introduction of horizontal grease grooves and with an additional grease nipple feeding the crown of the box. The Committee recommends that these trials on the Central Railway should continue and that they should be extended to the Eastern and Western Railways. The position should be reviewed at the next meeting.

Para 21. The Committee also considered the Research Directorate's Report No. 53 and recommends the following:

- (a) That the decision already taken to increase the diameter of the leading and trailing journals should be implemented.
- (b) That in view of the criticism of the standard of running shed maintenance, Railways should take steps to ensure that this is brought up to the required degree of efficiency in all sheds.
- (c) That to facilitate detection of hot axles by engine crews, bearing temperature sticks should be used.
- (d) That in view of the improvement in bearing temperatures, which has now been obtained on all Railways, further trials by the Research Directorate should be deferred. The Committee, however, reiterates its previous recommendation that roller bearing axleboxes should be provided on the coupled axles of all future passenger locomotives.

Para 22. The Committee noted the following:

- (a) Railways are already changing the 'Franklin' lubrication arrangement to the 'Ajax' system and the R.D.S.O. has advised Railways that Tisco expanded metal quality steel is suitable for the perforated plates.
- (b) The R. D. S. O. has also advised Railways that 7 SWG spring steel wire is adequate for the springs on the 'Ajax' follower plate.

Para 23. The Committee recommends that trials should be carried out with 'Athermos' axleboxes on 3 WP locomotives to be built at Chittaranjan. The R.D.S.O. should also examine the possibility of fitting these boxes to 3 WG locomotives at present on order at Chittaranjan.

Railway Board's Orders

Para 20. Noted. Eastern and Western Railways should carry out trials with the lubricating arrangement shown in CSL Drawing 2495 Alt. 1 and CSO Sketch L514 and report in time for consideration at the next LSC meeting.

Para 21. (a) Approved.

(b) Noted.

(c) R. D. S. O. to issue directive to Railways.

(d) Approved. R. D. S. O. should defer further trials.

The application of roller bearing axleboxes on coupled axles of WP locomotives is approved. In respect of other passenger locomotives, roller bearing axleboxes should be specified for coupled axles of imported steam locomotive and considered as a permissible alternative for indigenously manufactured passenger locomotives.

Para 22. (a) & (b). Noted.

Para 23. Approved. Trials with 'Athermos' axleboxes of the coupled axles of 3 WP and 3 WG locomotives to be built by Chittaranjan Locomotive Works are approved. R. D. S. O. to take necessary action.

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Item No. 13

Subject	L/MISC.		
Description	MISCELLANEOUS.		
LSC References		
CSO File reference	<div style="display: inline-block; vertical-align: middle; font-size: 3em; line-height: 1;">}</div> LSC/XXXIII Letter No. 52/731/1/M of 30-7-52 to all GMs.	S. No.	
		(RB)	(17)
Class of loco concerned . . . . .	..	
Trial No. (if any) . . . . .	..	
Agenda	TO ELECT THE MEMBERS OF THE SUB-COMMITTEE OF THE XXXVIII LOCO STANDARDS COMMITTEE.		
Notes by Secretary	In terms of Railway Board's letter No. 52/731/1/M of 30-7-1952, the XXXVI Loco Standards Committee elected the C.M.Es./ Central & Western Railways, to serve on the Sub-Committee of the XXXVII LSC.		

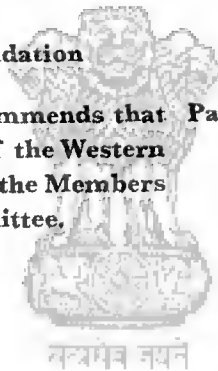
Members are requested to elect two members for the Sub-Committee of the XXXVIII LSC to be held in 1957/58.

Committee's Recommendation

Para 24. The Committee recommends that the Chief Mechanical Engineers of the Western and Central Railways should be the Members of the XXXVIII LSC Sub-Committee.

Railway Board's Orders

Para 24. Approved.





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APPENDIX I TO ITEM No. 5

Steam Vs. Diesel Cranes.

The Indian Railways have so far used steam and hand cranes to the exclusion of all other type for Breakdown and Transportation services. In recent years Diesel powered cranes have so developed that they are now accepted in large numbers by railways all over the world. The relative merits of these two types of cranes are listed below:—

- (i) *Overall Moving Dimensions including Tail radius etc.*—By the very nature of its design the steam powered crane would be of larger dimensions and hence restrictive in its manoeuvrability.
- (ii) *Operational restrictions, due to safety measures.*—The coal fired steam boiler of a steam powered crane prohibits the use of such a crane for commercial work in areas where fire hazards are present, such as oil depots, inside warehouses and goods sheds etc.

A diesel powered crane, provided with a suitable explosion prevention device can, on the other hand be safely used for such work.

- (iii) *Crane availability.*—The steam powered crane loses considerable time in raising steam, taking coal and water, cleaning fire and ashes etc. It is estimated that nearly 20% of the total time in commission is spent for such ancillary duties with the result that the crane is available for only about 80% of the total period.

On the other hand, the Diesel crane is instantaneously available at all times, and allowing for the time required for periodical fuelling and checking of cooling water etc., it may be safely assumed that the availability of such a crane is well above 95%.

Increased availability of the crane is of special importance for work in goods sheds etc. where the difference in availability per day may mean the difference between having one diesel powered crane and two steam operated cranes.

- (iv) *Standby losses.*—Many crane duties are intermittent and in a steam crane, once steam is up and the crane is required from time to time, the boiler will continue to consume proportionate fuel whether the crane is working or not.

The Diesel crane, however, need consume only when it is actually working as the power unit can be shut down even for short intervals.

- (v) *Preparation for work.*—A steam powered crane of average size requires 2-3 hours to get up full steam in the boiler before it can go into commission.

The Diesel crane is instantaneously ready for service provided fuel oil, lubricating oil and cooling water have been previously checked.

This ready availability of the Diesel crane is of great advantage in respect of Breakdown and Relief Services, which could be correspondingly speeded up.

- (vi) *Fuel Consumption.*—The average coal consumption for a 20-ton steam crane is approximately 85 lbs. per working hour which at current average coal prices would be equivalent to Rs. 1.14 (approx.) per working hour.

On the other hand, the average fuel consumption of a 20-ton Diesel powered crane is approximately 30 lbs. of fuel oil per working hour, which amounts to approx. Rs. 4/- per working hour. There is no doubt that in most cases on the Indian Railways, the Diesel powered crane would be costlier on fuel, but this advantage has to be considered in relation to the other advantages of availability etc.

- (vii) *Personnel.*—Except for the small coaling cranes, the average and larger size steam powered cranes must be manned by a crane driver and a fireman, if more time is not to be lost by making the crane driver maintain steam in the boiler as well.

Diesel powered cranes of all sizes need to be manned by a single operator only.

The saving of crew wages in respect of the Diesel crane thus mitigates to a certain extent the higher fuel costs.

- (viii) *Maintenance.*—The maintenance of the steam powered crane is a relatively simple matter and well within the capabilities of the normal steam running shed staff.

While the maintenance of a Diesel powered crane is not much more than in the case of the steam powered crane, there is no doubt that specialized staff would have to be provided for efficient maintenance in a shed which does not otherwise deal with Diesel powered units.

This is a handicap which must be borne in mind when considering the adoption of Diesel powered cranes.

- (ix) *Price.*—Present indications are that the price of a Diesel powered crane is higher than that of a corresponding steam crane, due basically to the higher cost of the Diesel engine and Transmission unit. The difference in price may be 15 to 20% the cost of a steam crane for transportation duties.

It must, however, be borne in mind that with builders all over the world now standardizing on Diesel powered cranes, such price is steadily going down, while the cost of steam cranes is on the increase due to the difficulty in standardization and the considerable drop in demand.

- (x) *Reliability.*—There is little doubt that the reliability of a steam powered crane is of the very highest order and in spite of all the improvements and developments so far achieved, the same measure of reliability cannot be claimed for the Diesel crane.

This is a factor of vital importance when considering Breakdown cranes, especially for passenger train accidents.

- (xi) *Capacity for indigenous manufacture.*—Information is at hand that certain indigenous firms are interested in the manufacture of Steam Cranes.

On the other hand, it does not appear likely that Diesel cranes would be manufactured in the country for some time to come.

A consideration of the factors enumerated above leads to the following recommendations:—

- (a) Diesel powered cranes can be adopted with advantage for transportation and commercial services. These cranes may include the following capacity:—

(i) Broad Gauge	20 ton.
	5 ton.
(ii) Metre Gauge	20 ton.
	5 ton.

- (b) The adoption of the Diesel powered crane for breakdown services should be deferred for the present until such time as more experience has been gained with similar cranes for transportation purposes, as detailed above. The chief reason for this recommendation is the lower reliability of the Diesel powered crane.

In those running sheds, however, where Diesel powered rail traction units have been introduced or are to be introduced in the near future, the provision of Diesel powered breakdown cranes may be accepted since adequate maintenance and other facilities would be readily available.

- (c) Steam powered coaling cranes for running sheds should not be replaced by Diesel powered units.

One other point in respect of Diesel powered cranes is the consideration of the type of transmission. For the horse powers involved, there is little to choose in respect of performance, reliability etc., between the electric and hydraulic transmissions. The decisive factor in the choice should be comparative price of the two units. Diesel Mechanical cranes are not recommended for adoption.

Requirements of M. G. Locomotive for—

		YP		YG		YL		YM	
		Rlys.	CSO	Rlys.	CSO	Rlys.	CSO	Rlys.	CSO
Central Rail- way	Passenger . . . A	20	20	..	..	..	..	3	3
	Goods . . . B	..	..	33+4	33+4	..	..	..	..
	Mixed . . . C	3	3	..	..	2	2	..	..
	Shuttle . . . D	..	..	..	..	..	..	14	14
	Passenger Yard E Shunting.	..	..	..	..	..	..	..	..
	Goods Yard F Shunting.	..	..	..	..	..	..	..	..
	TOTAL	23	23	37	37	2	2	17	17
Western Rail- way	Passenger . . . A	155	155	..	..	47	47	11	11
	Goods . . . B	..	..	147	147	20	20	..	..
	Mixed . . . C	Included under passen- ger.	..	Includ- ed under goods	..	12	12	6	6
	Shuttle . . . D	..	..	..	..	8	8	34	34
	Passenger Yard Shunting.	..	..	..	..	..	..	30	30
	Goods yard Shunting.	..	..	..	..	..	..	50	..
	Banking . . . G	..	..	..	..	..	..	..	..
	TOTAL .	155	155	147	147	87	87	131	81
Northern Rail- way	Passenger . . . A	94	94	..	..	6	6	..	..
	Goods . . . B	..	..	83	83	..	..	..	..
	Mixed . . . C	Includ- ed under passen- ger.	..	..	..	..	..	..	..
	Shuttle . . . D	..	..	..	..	..	..	..	..
	Passenger Yard Shunting.	..	..	..	..	..	..	..	..
	Goods Yard Shunting.	..	..	..	..	..	..	..	..
	Banking . . . G	..	..	..	..	..	..	..	..
	TOTAL .	94	94	83	83	6	6	..	..
North Eastern Railway	Passenger . . . A	245	245	..	..	76	76	..	..
	Goods . . . B	..	..	226	226	47	47	2	2
	Mixed . . . C	18	18	..	..	64	64	16	16
	Shuttle . . . D	..	..	..	..	..	..	57	57
	Passenger Yard Shunting.	..	..	..	..	2	2	79	79
	Goods Yard Shunting.	..	..	78	78	8	8	..	..
	Banking . . . G	..	..	1	1	9	..	..	9
	TOTAL .	263	263	305	305	206	197	154	163
Southern Rail- way	TOTAL . . .	71	71	92	92	2	2	..	..
	GRAND TOTAL .	606	606	664	664	303	294	302	261

Requirements of M. G. Locomotives—

		YP		YG		YL		YM	
		Rlys.	CSO	Rlys.	CSO	Rlys.	CSO	Rlys	CSO
Central Railway	Passenger . . A .	20	20	..	..	..	..	3	3
	Goods . . . B .	..	..	33+4	33+4	..	..	..	..
	Mixed . . . C .	5	5	..	..	..	..	..	..
	Shuttle . . . D	..	..	..	..	..	..	14	14
	Passenger Yard Shunting. E .	..	..	..	..	..	..	..	..
	Goods yard Shunting. F .								
	TOTAL . . .	25	25	37	37	..	..	17	17
Western Rail-way	Passenger . . A .	188	175	..	..	44	36	4	4
	Goods . . . B .	..	..	165	65	..	..	..	..
	Mixed . . . C .	Included passenger	under	Included goods.	under.	16	12	6	..
	Shuttle . . . D .	..	..	..	..	12	12	34	..
	Passenger Yard Shunting. . . E .	..	..	..	..	..	..	30	30
	Goods Yard Shunting. . . F .	..	..	..	..	..	..	..	..
	Banking . . . G	..	..	..	..	..	..	..	..
	TOTAL . . .	188	175	165	65	72	60	74	34
Northern Rail-way	Passenger . . A .	126	126	..	..	6	6	..	..
	Goods . . . B .	..	..	169	169	..	..	..	..
	Mixed . . . C .	Included under passenger.	..	..	..	..	..	..	..
	Shuttle . . . D	..	..	..	..	..	..	..	..
	Passenger Yard Shunting. . . E	..	..	..	..	..	..	53 Suitably modified.	..
	Goods Yard Shunting. . . F	..	..	..	..	..	..	..	..
	Banking . . . G	..	..	..	..	..	..	..	..
	TOTAL . . .	126	126	169	169	6	6	53	..
North Eastern Railway	Passenger . . A .	430	400	..	..	..	..	..	..
	Goods . . . B .	..	..	350	297	..	..	3	3
	Mixed . . . C .	31	31	..	..	69	21	17	7
	Shuttle . . . D .	..	..	..	..	..	..	63	18
	Passenger Yard Shunting. . . E .	..	..	..	..	3	..	99	..
	Goods Yard Shunting. . . F .	..	..	86	..	6	..	..	..
	Banking . . . G .	..	..	1	..	9	..	..	10
	TOTAL . . .	461	431	437	297	87	21	182	38
Southern Rail-way		71	41	92	67	2	2	..	..
GRAND TOTAL . . .		871	798	900	635	167	89	326	89

Contd.

for proposed Services

YS		Heavy Passenger Loco.		Heavy Goods Loco.		Garratt		Proposed 2-8-4 Tank	
Rlys.	CSO	Rlys.	CSO	Rlys.	CSO	Rlys.	CSO	Rlys.	CSO
..
..
..
..
14	14
14	14
..	20	..	..	..	..	7	7
..	100	..	..	5	5
..	6+4
..	34
..
..	50	50
..	8	8
..	20	..	100	..	..	70	114
..
..
..
..
..
12 Suitably modified.	12
..
12	12
..	30	..	..	..	..	..	..
..	11	64	..	..	..	..
..	9	9	..	..	..	10+48
..	45
..
..	86
..
..	30	20	73	..	..	..	189
..	30	..	25	..	..	..	..
26	80	20	198	..	..	70	329

APPENDIX III to ITEM No. 6

Performance data of Proposed 4-8-2 heavy Passenger (M.G.) Locomotives

Railway	Performance Requirements of Railways.			Performance obtainable by 4-8-2 Heavy Passenger Loco.		
	Load Tons.	Speed Mph.	Gradient	Load Tons.	Speed Mph.	Gradient
1	2	3	4	5	6	7
Northern	Existing	Power	adequate.			
Central	Existing	Power	adequate.			
Southern	420	25	1/100	(1) 350 or (2) 450	25 20	1/100 1/100
Western	405	15	1/100	450	20	1/100
	325	5	1/75	450	5	1/75
	460	23	1/100	450	20	1/100
North-Eastern	560	20	1/68	(1) 295 or (2) 400	20 10	1/68 1/68
	560	20	1/100	450	20	1/100



APPENDIX IV TO ITEM No. 6

Performance data of proposed 2-8-4 (M.G.) Tank Locomotives

Railway	Service.	Performance Requirements of Railways.			Performance obtainable by 2-8-4 Tank (M. G.) Locomotive.		
		Load Tons.	Speed Mph.	Gradient*	Load Tons.	Speed Mph.	Gradient
1	2	3	4	5	6	7	8
North-Eastern	Shuttle	560	20	1/150	485	15	1/150
					362	20	1/150
Central	Shuttle	200	20	1/133	330	20	1/133
Western	Shuttle	325	16	1/150	362	20	1/150
Southern	Shuttle	270 (240)	25 (20Alt)	1/100	252	20	1/100
Northern	Shuttle	Dieselisation contemplated by Railway.					
North-Eastern	YL and YM adequate for	Passenger and Goods Shunting.					
Central	Goods Shunting	705	5	1/133	698	5	1/133
Central	Pass. Shunting.	Existing Power adequate.					
Western	Pass. Shunting	460	10	1/150	670	10	1/150
Western	Goods Shunting.	1400	5	1/150	760	8	1/150
Northern	Pass. Shunting.	Existing Power adequate.					
Northern	Goods Shunting.	1700	10	1/400	1400	8	1/400
Southern	No Remarks offered by Railway.						
North-Eastern	Shuttle	320	20	1/50	162	15	1/50

*Length of gradient not known.

APPENDIX V TO ITEM 'No. 8'

List of permissible alternatives appearing in Appendix IV of XXIX L.S.C. Report and as modified by recommendations made at the XXX to XXXVI Meetings and showing requisitions recommended by the XXXVII L.S.C. and Railway Board's orders made to paragraphs 11 and 12
[see appendix V(a) & (b) also,]

Group Modification number	Authority	Description	Standard	Permissible alternatives	Remarks	Committee's Recommendations	Railway Board's orders
1	2	3	4	5	6	7	8
AB. 2.004	XIII LSC-12 XIX LSC-112	Axle box grease cellars and equipment	(1) Ajax	(2) Franklin.	..	"Franklin" lubricator to be deleted as a permissible alternative.	Approved.
AB. 2.052 AB. 2.031	XXIV LSC-9 XXVII LSC-60	Lucridation of axle boxes.	(1) Hard grease.	(2) Oil.	..	Hard grease lubrication to be standard for : (i) coupled axles excluding shunting locomotives. (ii) Oil to be standard for carrying axles.	Approved.
AB. 2.061 AB. 2.062	XXXVI LSC-1	Axle box lubricator keep end plate.	(1) Fabricated design.	(2) Cast iron design.	..	..	..
AB. 2.002 TB. 3.002	XV LSC-8 XVI LSC-7 XXIV LSC-15 XXIX LSC-75 XXX VLSC-57	Roller bearing axle boxes.	..	(1) Timken (2) SKF. (3) Hoffmann. (Made in India)	For B. & M. G. locos. Application of Hoffmann boxes manufactured outside India, restricted to 20% of the total locos on order.	Roller bearings to be standard for narrow gauge carrying axles also.	Approved.
BG. 2.008 BG. 2.030	XVI LSC-7 XXVI LSC-119 XXIX LSC (app : 111)	Type of brake on engine.	..	(1) Vacuum. (2) Steam (on large engines.)	..	Vacuum brake to be standard for both engine and tender. Steam brake to be included in the list of permissible alternatives for application where vacuum brake is not possible.	Approved.
BG. 2.031	XIII LSC-12	Lubrication of brake rigging.	(1) Soft grease	(2) Oil.	..	..	..
BM. 3.002	XV LSC-29 XXVI LSC-31	Blow off cock.	..	(1) "Everlasting." (2) "Evril" (3) "Hopkinson"	..	"Hopkinson" to be deleted from the list of permissible alternatives.	Approved.
BM 3.015	XVI LSC-7	Soot Blowers	..	(1) "Parry" (2) "Diamond" (3) "Clyde"	..	Soot Blowers to be deleted from list of permissible alternatives.	Approved.
BM 2.032	XXII LSC-51	Material of washout plugs.	(1) Bronze Class II to IRS Specn. N. 6.	(2) Brass Bars to IRS Specn. N. 2	.. ..	Brass bars to be deleted as a permissible alternative.	Approved.
CL. 4.010	XXXII LSC-44	Cylinder water relief valves.	(1) IRS pattern	(2) Ex. M.S.M. Rly. design. (3) Ex. G.I.P. Rly. design.	.. .. ..	I.R.S. Steel casting design to be standard and the I.R.S. fabricated design to be a permissible alternative. Other designs to be deleted.	Approved.
CL. 4.011	XXXII LSC-38 CSO letter No. IL/PDS/Cir. : T of 18-6-56.	Material of Byc pass valve plunger.	(1) Stainless Steel.	(2) Steel Class III to IRS Specn. M. 3. (3) Steel Class X to IRS Specn. M. 26.	..	..	..
CR. 2.008	XVI LSC-7 XXIII LSC-1 XXIX LSC-62	Lubrication of connecting rod big end and coupling rods.	(1) Hard grease.	(2) Oil.	Hard grease nipples to be located on rods or crank pins to meet design requirements.	..	..

APPENDIX V—Contd.

1	2	3	4	5	6	7	8
CR. 2.009	XIII LSC-12 XXIII LSC-1	Lubrication of coupling rod knuckle pin.	(1) Soft grease	(2) Oil.	..	..	..
CR. 2.009	XIII LSC-12 XXIII LSC-1	Lubrication of connecting rod little end (gudgeon pin)	(1) Soft grease	(2) Oil.	..	..	..
CR. 2.004 CR. 3.001	XIII LSC-55 & 56 XXIX LSC. app: IV.	Bearing for connecting rod big end and driving eye of coupling rod.	(1) Floating bush.	(2) Roller bearing of approved design.	..	..	..
EJ. 2.012	XXVI LSC-36 XXI LSC-92 XXVI LSC-app: II XXXIII LSC-21	Ejector	(1) S.J. G.R.H. for goods locos. S.J. 'P' R.H. for passenger locos.	(2) Davies and Metcalfe type R.H.	Ejectors to be fitted with graduable steam brake valves, where necessary.	Davies and Metcalfe ejectors to be deleted from list of permissible alternative.	Approved.
EQ. 3.024	XVI LSC-7	Electrical Equipment.	..	(1) Stone. (2) Pyle. (3) Sunbeam.	..	..	..
EQ. 3.034	XXX LSC-128 XXXIV LSC-64	Buffer Lamps	(1) Cast Iron (non swivelling type)	(2) Cast Iron (Swivelling type). (3) Fabricated. (swivelling type).	..	Fabricated design to standard and the cast iron design of non-swivelling type to be a permissible alternative.	Approved.
EQ. 2.009	XXIX LSC-84	Grease Guns.	..	(1) Of approved make to the preference of railways.	..	..	..
FG. 2.016	XXIII LSC-1	Grate air spacing.	..	As required.	..	..	..
FR. 2.001	XIII LSC-12 XXIV LSC-81	Lubrication of horn faces.	(1) Oil.	(2) Soft grease.	..	..	..
FX. 2.019	XVIII LSC-1	Material of water space stays.	(1) Steel Class VI to IRS Specn: N. 7	(2) Long strand Steel. (3) Yorkshire Iron (4) Dunic Steel. (5) Stag super Fibro stay bolt steel (Edgar Allen). (6) Stay bolt (Novo Steel). (7) Titanic (samuel osborn).	..	Only those brands which are in current production should be included in the list of permissible alternatives.	R. D. S. O. to take necessary action.
FX. 4.001	XXVI LSC-6	Thermic syphon.	(1) To be provided wherever width of firebox permits.	..	..	..	..
GL. 2.004 GL. 2.005	XIX LSC-59 XXIX LSC-83.	Grease nipples.	(1) I. R. S. design.	(2) Of other approved make to the dimensions shown on CSL 1680.	..	..	..
I.R. 2.019	XXXII LSC-19	Injector	(1) Simplex.	(2) R. G. W.	..	..	..
LB. 2.005	XV LSC-89 XXX LSC-136	Hydrostatic Lubricator.	(1) Wakefield 'AC'	(2) Vacuum oil Co's H. O. type. (3) Detroit.	..	..	..
MN. 2.005	XXV LSC-47 XXXII LSC-40	Material of reversing link die block.	(1) Steel Class I, case hardened.	(2) Bronze Class I.	..	..	..
MN. 2.003 MN. 3.008	XIII LSC-12 XVI LSC app: I.	Lubrication of motion and reversing gear.	(1) Soft grease.	(2) Oil	..	Oil to be deleted from the list of permissible alternatives.	Approved.
OC. 2.010	XXXV LSC-51	Oil boxes	(1) Malleable cast iron.	*(2) Fabricated *(3) Composite	*For emergency use on Railways only.	Malleable cast iron to be deleted from the list of permissible alternative.	Approved.

APPENDIX V—Contd.

1	2	3	4	5	6	7	8
PC. 2.006 PC. 2.019 PC. 2.020	XII LSC-96 XXVI LSC-36	Pipes for al- locations to be of steel except pres- sure and vacuum gau- ges.	(1) Steel	(2) Copper	Steel pipes of steam quali- ty to be used when sub- jected to boiler pres- sure.	..	..
PC. 3.010	XXXII LSC-106	Pipe coupl- ings, tees elbows. etc.	(1) Steel	(2) Malleable cast iron.	..	..	..
PK. 2.004	XVII LSC-62 XXIII LSC-1	Piston rod packing.	(1) Paxton Mitchell.	(2) Brittallic.	..	(12) When indige- nous manufacture of Paxton Mitchell packing is establi- shed, this type should be adopted as standard, retain- ing the Brittallic cast iron packing as a permissible alterna- tive on existing lo- comotives.	(12) Britta- lic cast iron pack- ing should continue as standard R. D. S. O. should refer the matter to the Rly. Bd. for fur- ther orders as and when indi- genous manufactur- es of Paxton Mitchell packing is established.
PX. 2.018 PX. 2.022	XXVII LSC-30 XXX LSC-55	Piston head above 18" diameter.	(1) Dished ty- pe with ri- vets on junk ring.	(2) Solid dished type cast iron.	..	..	..
RG. 2.013	XXIX LSC-app. IV.	Regulator	(1) "Joco"	(2) "Owens"	..	..	..
SN. 3.017	XXIX LSC-app. IV.	Lubrication of spring gear.	(1) Soft grease	(2) Oil.	..	..	..
WL. 2.023	XXX LSC-75	Wheel cen- tres, coupled.	(1) Spoked. (2) "Box Pok" for WP lo- cos only.	(3) "SCOA-P"	..	..	..
WL. 2.024	XXXVI LSC-38	Material of wheel hub liners.	(1) 11 to 14% manganese steel.	*(2) Cast Iron.	*For inde- genous ma- nufacture.	..	..

APPENDIX V (a) To ITEM No. 8

Items which are no longer standard or permissible alternatives as per Railway Board's orders in para 11 of XXXVII LCS

Group Mod. No.	Description.
AB. 2.004	“Franklin” axle box grease lubricator.
AB. 2.031 AB. 2.052	“Oil” lubrication of coupled axle boxes for all locos except shunting locos.
BM. 2.032	“Brass bars to IRS Specification N2” material for washout plugs.
BM. 3.002	“Hopkinson” blow off cock.
BM. 3.015	“Parry”, “Diamond” and “Clyde” soot blowers.
CL. 4.010	“Ex G.I.P. and Ex. M. & S. M.” designs of cylinder water relief valves.
EJ. 2.012	“Devies and Metcalfe” Ejector.
EQ. 3.034	“Cast Iron, swivelling type” buffer lamp.
FX. 2.019	“Stag super fibro stay bolt steel and stay bolt (Novo) steel” materials for water space stays.
MN. 2.003 MN. 3.008	“Oil” lubrication for motion and reversing gear.
OC. 2.010	“Malleable cast iron” oil boxes.



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APPENDIX V (b) To ITEM No. 8

Authorised list of permissible alternatives (Revised up to XXXVII L.S.C.)

Group Mod. Number	L.S.C. Para Report	Description	Standard	Permissible alternative	Remarks
1	2	3	4	5	6
AB. 2.069 .	XXXVII LSC . Para 11.	Lubrication of plain bearing coupled axle boxes for shunting locos only.	(1) Hard grease.	(2) Oil.	
AB. 2.061 . fiAB 2.062 .	XXXVI-1	Designs of axle box Lubricator keep end plate.	(1) Fabricated	(2) Cast Iron.	..
AB. 2.070 . AB 4.003 .	XXXVI-1 . XXXVII-21(d)	Coupled axle boxes for Passenger locos.	(1) Roller Bearing.	(2) Plain bearings for indigenous manufacture only.	..
AB. 4.004 . AB. 5.011 . TB. 3.009 .	XV-8, XVI-7 . XXIV-15 . XXIX-75 . XXXV-57 . XXXVII-11 .	Roller bearing axle boxes .	(1) Timken. (2) SKF (3) Hoffmann (Made in India)	..	Application of Hoffmann axle boxes manufactured outside India to be restricted to 20 % of the total locos on order.
BG. 2.037 .	XXXVII-11 .	Type of brake on engine .	(1) Vacuum.	(2) Steam, where application of vacuum brake is not possible.	..
BG. 2.031 .	XIII-12 .	Lubrication of brake gear .	(1) Soft grease.	(2) Oil.	..
BM. 3.002 .	XV-29 . XXVI-31 . XXXVII-11 .	Blow off cocks .	..	(1) Everlasting. (2) Evrit.	.. ..
CL. 4.014 .	XXXVII-11 .	Cylinder water relief valve bodies.	(1) Cast Steel.	(2) Steel Class II.	..
CL. 4.011 .	XXXII-38 . XXXVII-11 .	Material for Bye pass valve plunger.	(1) Stainless Steel.	(2) Steel Class III (3) Steel Class X.	.. ..
CR. 2.008 .	XIII-12 . XVI-7, XXIII-1 XXIX-62 .	Lubrication of connecting rod big end eye and coupling rod eyes	(1) Hard Grease.	(2) Oil.	Hard grease nipples to be located on rods or crank pins to meet design requirements.
CR. 2.009 .	XIII-12 . XXIII-1 .	Lubrication of connecting rod little end/gudgeon pin.	(1) Soft Grease.	(2) Oil.	..
CR. 2.009 .	XIII-12 . XXIII-1 .	Lubrication of coupling rod knuckle pins.	(1) Soft Grease.	(2) Oil.	..
CR. 2.004 .	XIII-55 . XXVI-84, 85 .	Bearings for connecting rod big end eye and driving eye of coupling rod.	(1) Floating bush.	(2) Roller Bearing of approved design.	..
EQ. 3.024 .	XVI-app : I XXIX-app : IV	Electrical equipment	..	(1) Stone. (2) Pyle. (3) Sunbeam.	.. .. ..
EQ. 3.040 .	XXXVII-11 .	Buffer lamp .	(1) Fabricated (swivelling type.)	(2) Cast iron (non-swivelling type).	..
FG. 2.016 .	XXIII-1 .	Grate air spacing .	..	As required.	..
FR. 2.001 . FR. 3.002 .	XIII-12 . XXIV-81 . XXXVII-11 .	Lubrication of axle box horn faces.	(1) Oil.	(2) Soft grease.	..
FX. 2.045 .	XXXVII-11 .	Material of water space stays.	(1) Steel Class VI to IRS Specification M.7.	(2) Longstrand steel. (3) Yorkshire Iron. (4) Dunic Steel. (5) Titanic Steel.	.. .. .. ..
FX. 4.001 .	XXVI-6 .	Thermic Syphon .	(1) To be provided wherever width of firebox permits.	..	..
GL. 2.004 . GL. 2.005 .	XIX-59 . XXIX-83 .	Grease nipples .	(1) I.R.S. design.	(2) Other approved make to the dimensions shown on CSL-1680.	..
I.R. 2.019 .	XXXII-19 .	Injector .	(1) Simplex.	(2) R.S.W.	..
LB. 2.005 .	XV-89 . XXX-136 . XXXVII-11 .	Hydrostatic lubricator .	(1) Wakefield 'AC'	(2) Vacuum oil Co's H. O. type. (3) Detroit.	.. .. ..
MN. 2.005	XXV-47 . XXXII-40 .	Material of reversing link die block.	(1) Steel, Class I, case hardened.	(2) Bronze Class I.	..
OC. 2.011 .	XXXVII-11 .	Designs of oil boxes .	(1) Fabricated design.	(2) Composite design in cast iron.	..

APPENDIX V (b)—Contd

1	2	3	4	5	6
PC. 2.029 .	XXVI-36 XXXVII-11 .	Material of pipes for all locomotives except pressure and vacuum gauges.	(1) Steel.	(2) Copper.	Steel pipes of steam quality to be used when subjected to boiler pressure.
PC. 3.010 .	XXXII-106 .	Material of pipe couplings tees, elbows etc.	(1) Steel.	(2) Malleable cast iron.	..
PK. 2.004 .	XXIX-app:IV XXXVII-12 .	Piston rod packing . . .	(1) Brittallic.	(2) Paxton Mitchell.	Paxton Mitchell packing to be standard when indigenous manufacture is established. Brittallic to be Permissible alternative for existing locos.
PX. 2.018 .	XXVII-30 .	Piston head above 18" diameter.	(1) Dished type with riveted on junk ring.	(2) Solid dished type of cast iron	..
PX. 2.022 .	XXX-55 .				
PX. 3.046 .	XXXVII-15,16	Material of Gudgeon pin .	(1) Steel Class IV flame hardened.	(2) Steel Class I case hardened.	..
RG. 2.013 .	XXIX-app. IV XXXV11-11	Regulator	(1) "Joco"	(2) "Owens"	..
SN. 3.017 .	XXIX-app. IV XXXVII-11 .	Lubrication of spring gear	(1) Soft grease.	(2) Oil.	..
WL. 2.023	XXXV-75 . XXXVII-11 .	Coupled wheel centres .	(1) Spoked. (2) Box pok for WP locos. only.	(3) SCOAP.	.. ..
WL. 2.024	XXXVI-38 .	Material of hub liners	(1) 11 to 14% manganese steel.	(2) *Cast Iron.	*For indigenous manufacture only.



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VIII—SUMMARY OF TRIALS

This summary has been prepared to secure co-ordination between Railways undertaking trials, and it is requested that separate reports be submitted in duplicate to this office by the dates given on the trial sheets.

The period of trials and general instructions are intended to serve as a guide only and may be modified at the discretion of Railways.

Reports are to be headed with serial number, title, and object of trials as described in the following summary, the body of report being divided into the following:—

- (i) Description of method of testing adopted if different to that given in the summary ;
- (ii) Results as far as possible in tabular form on foolscap size paper ; and
- (iii) Conclusions.

(a) Current and to continue

Trial No.	L.S.C. Ref.	Railway undertaking trial	Title of trial	Object of trial	General Instructions	
					Number and type under trial	Period of trial
1	2	3	4	5	6	7
1 TLA 2.2	XXXIII 1 XXXV 17	All.	Electric resistance welded boiler tubes.	To obtain comparative performance data of ERW and solid tubes.	Passenger . 4 Goods . 4 Shunting . 4 In addition to 3 WG/YP engines built by CLW and TELCO.	No. of years of 2 POH (with interim report after 1 st POH).
2 TLA 3.7	XXXV 44 XXXVI 19	Eastern.	Thermic syphon, butt welded to throat plate diaphragm.	To compare the efficiency of the butt-welded design with the fillet welded design.	10 CLW built WGS.	2 POH periods after being commissioned.
3 TLB 4.2	XXIX 11-12 XXXI 22 XXXV 50	Central, in Co-operation with Research Dte	Mechanical stoker	To determine whether mechanical stokers are justified for locos employed over sections where firing capacity is providing up to or beyond the limit of manual firing.	..	..
4 TLC 7.1	XXXIII 6 XXXV 67	All	Expanded Metal Spark Arrestors	To determine performance and life of the expanded metal spark arrestors as compared with standard "Draftac".	3 locos to be fitted with each of the 3 types of spark arrestors.	Life limit of the expanded metal spark arrestors.
5 TLD 7.4	Railway Board No. 54/467/59/M of 22-7-54.	Central.	FRIEDAMANN'S Hydrostatic displacement lubricator, Class RN (2-feed).	To compare efficiency of lubrication, economy in oil consumption and relative maintenance costs of the 'RN' lubricator against the Standard Wakefield's lubricator in use in order to determine if the 'RN' lubricator can be accepted as a Permissible Alternative.	Loco No. 2113 YP and one fitted with standard, Wakefield's 2-feed sightfeed, hydrostatic lubricator.	100,000 miles or POH.
6 TLD 7.5	RB letter No. 54/467/59/M of 22-7-54.	Central.	Friedamann's Hydrostatic displacement lubricator, Class RN (4-feed).	To compare efficiency of Lubrication, economy in oil consumption and relative maintenance costs of the 'RN' lubricator against the standard Wakefield's lubricator in use, in order to determine if the 'RN' lubricator can be accepted as a Permissible Alternative.	Loco No. 8642 WG and one fitted with standard Wakefield's 4-feed, sightfeed Hydrostatic lubricator.	100,000 miles or, POH.
7 TLD 7.6	XXXVI 21	Northern	Wakefield Convergent Jet Atomiser.	To compare the relative wear and carbonisation on piston valve liners and rings of locos fitted with Wakefield's Convergent Jet Atomisers as against those having conventional type of lubrication connection to the steam pipe.	4 WGs - 2 Nos. with Convergent Jet Atomiser & 2 Nos. with conventional type of lubrication to the steam pipe.	60,000 miles.
8 TLD 7.7	XXXVI 37	Central, Northern, S-Eastern, N-Eastern.	Nalco Wheel Flange Lubrication.	To study the extent of reduction, if any, in flange wear with the use of Nalco Flange Lubricators.	Central, on BG & NG, Northern, on NG, S-Eastern, on BG, N-Eastern, on MG, class to be selected by the Railways.	On full period between consecutive tyre turnings.

Current and to continue—Contd.

1	2	3	4	5	6	7
9 TLE 4.2	XXXIV 32 XXXV 39	All B G Railways	Wedge adjusting Bolt,	To evolve a suitable design of wedge adjusting bolt Barframe locomotives.	6 WPs as under:— 2 WPs to be fitted with wedge adjusting bolt to CSL drg. No. 2256 Alt. 1. 2 WPs to be fitted with wedge adjusting bolt to Southern Rly's Sketch No. 2708/BG. 2 WPs to be fitted with wedge adjusting bolt to C. E's drg. No. E/SL-126/140.	60,000 miles
10 TLE 4.3	XXXV 38	ALL.	Wedge Adjusting arrangement for plate frame locomotives.	To evolve a suitable design of wedge adjusting arrangement for plate frame locomotives.	One each of XA/XB & XD, XB/XC & XE, XA/XB/XC, YB & XD, XD, XC on C, E, N, S, S-E & W. Rlys. resp. on BG, & one YB & YD on CR, one YB & YD on NR, one YB, on NE, one YB/YC and YD, on SR, and 1 YB and YD, on WR.	60,000 miles.
11 TLF 2.3	XXXIV 39 XXXV 52 XXXVI 27	Central.	Modified double taper form of piston rod crosshead connection.	To find out if this arrangement reduces maintenance costs and performance as compared with standard double taper pin.	2 WG class - One with trial fittings on LH side & standard fittings on RH & the other with the trial fittings on RH side and standard fittings on LH side. The two locos with trial fittings are to be employed on the same division and on similar service.	P.O. to P.O.
12 TLG 3.12	XXXVI 24	All	Case H ardened Steel Motion Bushes.	To compare performance of casehardened motion pins working in casehardened steel motion bushes, as compared with similar pins working in bronze bushes.	6 BG and/or 6 MG locos - WP, WG, YP, YG for grease lubrication; Rlys. to select locos for oil lubrication.	18 months.
13 TLL 2.10 (Mod)	XXXI 71-72 XXXII 62 XXXIII 47	Central.	Liners of Tatas 'Nimn' Brand Manganese Nickel steel in rubbing contact for coupled and bogie wheel axlebox channels and guides and coupled wheel axlebox face and wheel hub liners.	To determine performance of trial material and extent of wear as compared with 11-14% manganese steel and other combinations in rubbing contact.	WM-1	100,000 miles after fitting trial liner.
14 TLL 3.3	XXIX 70 XXX 100 XXXI 75 XXXII 66 XXXV 57	SE. (ex-BN)	Hoffmann roller bearing axleboxes for inside & out side carrying wheels.	To compare performance with carrying wheel roller bearing axleboxes of the Timken and Skefko designs with a view to determining whether the designs are suitable for acceptance as permissible alternative.	2 XD class locos, 1 with Hoffmann & other with Timken bearings. 3XC class locos, 1 with Timken, 1 with Hoffmann and third with Skefko.	P.O. to P. O.
15 TLL 3.4	XXIX 70 XXX 101 XXXI 76 XXXII 66 XXXIII 46 XXXV 53	South-Eastern, Central	Roller bearing axleboxes for inside & outside carrying wheels.	To compare performance with carrying wheel roller bearing axleboxes of the Timken, Skefko and Hoffmann designs with a view to determining whether the designs are suitable for acceptance as Permissible Alternatives.	Ex-GIP, 1 WG loco with SKF. Ex-GIP, 1 WG loco with Timken, Ex-BN, 1 WG loco with Hoffmann.	P.O. to P.O
6 TLL 4.9	XXXV 55	All	Shell Alvania Grease 3 for tender axleboxes fitted with roller bearings.	To standardise one type of lubricant for roller bearing axleboxes of the three makes used on locomotive carrying axles.	As detailed in the covering letter No. SL/LB/I of 30th August, 1955.	

(a) Current and to continue—Contd.

1	2	3	4	5	6	7
17	..	XXXVI-18/ SL/FXS/III of 30-3-56 to DR/LKO	..	Security Circulator Arch Tubes	To compare performance of boilers fitted with thermic syphon with boilers fitted with security arch tubes only.	1 WG (CLW)
18	..	XXXVI-29/ SL/WG/IM/ SH of 1-9-56	All	Regulator Locking Device to Western Railway drawing LCB-1943. CSL Drg. 2532.	To review alternative de- signs of regulator locking devices on locomotives and to decide on the future Standard.	6 BG, 6MG on each Rly.
19	..	XXXV/54, SL/WP/RB of 17-8-56.	..	SKF Roller bear- ings direct moun- ted on return cra- nk journal with- out the removable sleeve.		10 CLW WGs.
20	..	XXXVI 17 (SL/WP/FR/ I).	Eastern, Central	Ballast Sweep with Strengthened cat- tle guards.	To consider provision of ballast sweep on loco cattle guards.	..



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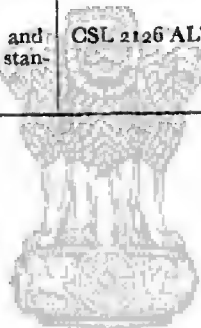
IX. SUMMARY OF MODIFICATIONS AUTHORISED BY THE RAILWAY BOARD IN CONNECTION WITH THE RECOMMENDATIONS OF THE XXXVI MEETING OF THE LOCOMOTIVE STANDARDS COMMITTEE.

1. The application of those modifications to I.R.S. Locomotives placed in service before 1947 is optional, but Railways are advised in their own interest, to incorporate these modifications when renewals of parts become necessary except, where expressly stated otherwise.
2. The application of these modifications to I.R.S. Locomotives placed in service after 1947 is obligatory and must be carried out in accordance with Railway Board's orders.
3. Drawings quoted under column "Sample drawings" in the table indicate the type of drawings on the lines of which the modification is to be carried out.
4. Under the column "Loco and Drawing reference", the class of Locomotives to which the particular modification is applicable is indicated. Drawing Nos. if prepared, are given below the class of Locos. When a modification is applicable to all IRS Locos, a remark is inserted to that effect. Drawings so far prepared for particular Locos are indicated, although the modification is applicable to other classes of Locos as well for which drawing have not yet been prepared.

Group Modification No.	Ref. para of XXXVII LSC report	Description of Modification	Sample drg.	Loco and drg. reference.	Remarks.
1	2	3	4	5	6
A.B. 2.065	11.22 (a)	Axle box grease lubricator of "Ajax" make to be standard.	..	All I.R.S. Locos	Supersedes Mod : AB. 2.004
A.B. 2.066	22 (a)	Axle box grease lubricator perforated plate may be made of TISCO expanded metal quality steel.	..	All I.R.S. Locos	
A.B. 2.067	22 (b)	Axle box grease lubricator springs for follower plate to be of 7 S.W.G.	..	WP. WG.	
AB. 2.068	11	Lubrication of coupled axle boxes to be hard grease.	..	All I.R.S. locos.	See also Mod : AB. 2.069, supersedes Mod : AB. 2.031 & 052.
AB. 2.069	11	Oil may be used as permissible alternative for axle box lubrication of shunting locos only.	..	I.R.S. Shunting locos only	See also Mod : AB. 2.068 supersedes Mod : AB. 2.031 & 052.
AB. 2.070 AB. 4.003	21 (d)	Roller bearing axle boxes to be provided on all imported passenger locos. Plain bearing axle boxes may be provided on locos manufactured indigenously.	..	I.R.S. Passenger locos only	For new builds only.
AB. 3.047 TB. 2.016	11	Lubrication of carrying wheel plain bearing axle boxes to be oil.	..	All I.R.S. Locos	
AB. 5.09	1 & 2	SKF axle boxes for Front Truck-WG locos : (a) Future purchases to be in accordance with M/S. SKF drawing 714940. (b) Existing axle boxes which have not yet cracked to be strengthened as per CSL 2580 (Proposal I). (c) Existing axle boxes which have already cracked to be strengthened as per instructions of R.D.S.O.	..	WG	
AB. 5.010 TB. 3.010	9 & 11	Roller bearing axle boxes to be provided on carrying wheels of engines and tenders.	..	All I.R.S. Locos.	Supersedes Mod : AB. 5.002.
BG. 2.035	5	Solid cast iron brake blocks to be provided on existing engines and tenders to the extent possible and to be standard for all future builds.	..	WP : WG : WM : YP : YG : YL : (Engine) WP : WG : YP : YG : YL (Tenders)	Supersedes Mod : BG. 2.028.
BG. 2.036	5	Tender brake gear to be modified for application of solid brake blocks.	CSL 2579	WP : WG : YP : YG : YL CSL 2579 CSL 2655	
BG. 2.037	11	Vacuum brake to be provided on locomotive engines and tenders. Steam brake may be provided on engines if application of vacuum brake is not possible.	..	..	Standard practice for all new locos.

1	2	3	4	5	6
BM. 2.032	11	Brass bars to IRS Specification N 2, material for wash-out plugs deleted from list of permissible alternatives.	..	..	..
BM. 3.002	11	"Hopkinson" blow off cock deleted from list of permissible alternatives.	..	..	..
BM. 3.015	11	"Soot blowers" deleted from list of permissible alternatives.	..	..	..
CL. 4.014	11	Bodies for cylinder relief valve Standard. Cast Steel, to I.R. Part Drg. L/CL. 604, 605. Permissible alternative. Steel Class II. to I.R. Part Drg :	..	All I.R.S. locos	Supersedes Mod : CL. 4.010.
EJ. 2.012	11	Davies and Matcalfe's ejector deleted from list of permissible alternative.	..	..	..
EQ. 3.040	11	Buffer lamps : Standard Fabricated (Swivelling type). Permissible alternative Cast Iron (Non-swivelling type).	CSI. : 2063 Alt. : 1 CSL. 2550 Alt. : 1	All I.R.S. locos	Supersedes Mod : EQ. 3.034. Permissible alternatives.
FX. 2.045	11	Material of water space stays Standard : (1) Steel Class VI to IRS Specn. M.7. Permissible alternatives. (2) Longstrand steel (3) Yorkshire iron (4) Dunic steel (5) Titanic (Small oblong)	..	All I.R.S. locos.	Permissible alternatives.
GEN 2.027	8 (d)	4-8-2- type. Metre gauge loco with double six wheeler bogie tenders for heavy passenger service approved	LD/ SK-76	New M.G. loco	..
GEN. 2.028	8 (c)	1100 HP Metre Gauge Diesel Locos for general purpose service approved.	LD/ SK-76	New M.G. diesel loco	..
GEN. 2.029	8 (f)	2-8-4. type Metre Gauge Tank loco for heavy shunting and shuttle service approved.	LD/SK. 79	New M.G. loco	..
GEN 2.030	10	400 HP and 600 HP Diesel units to be standard for Broad Gauge shunting service.	..	..	..
GEN 2.031	7 (a)	Permissible axle loads to be reviewed for designs of cranes.	..	Standard cranes	..
GEN. 4.012	14	Principle of adopting fabricated components in lieu of cast steel accepted as an emergency measure	..	For all I.R.S. locos.	..
PC. 2.029	11	Pipes for all locations except pressure and vacuum gauges to be steel. Copper pipes may be used as a permissible alternative	..	All I.R.S. locos.	..
MN. 2.016	11	Lubrication of motion to be soft grease only	..	All I.R.S. locos.	..
MN. 3.023	11	Lubrication of reversing gear to be soft grease only.	..	All I.R.S. locos.	..
OC. 2.011	11	Design of oil boxes; Standard (1) Fabricated design Permissible alternative. (2) Cast Iron composite designs.	..	All I.R.S. locos. (1) LA/OC-156, 157 & 158. (2) LA/OC-151A, 152A & 153A	..

1	2	3	4	5	6
PK. 2.004	12	Piston rod packings. Brittalic to be standard till indigenous manufacture of Paxton Mitchell packing is established. Paxton Mitchell to be permissible alternative, but to be the standard when indigenous manufacture is established.	..	..	..
PX. 3.046	15,16	Material of gudgeon pin to be. — (1) Steel Class IV-flame hardened (Standard). (2) Steel Class I casehardened where flame hardening cannot be observed. Procedure for correct heat treatment to be as laid down by R.D.S.O.	—	..	..
PX. 3.047	17	Diameter of grease reservoir in gudgeon pin to be reduced to $\frac{3}{4}$ " from 1-1/16".	..	All I.R.S. locos WPL/PX619A YP WG 1/PX609A L/LPX649A YG/L/PX649A	—
TY. 2.009	18	Condemning tyre profiles & condemning gauges for tyres standardized.	CSL. 2222ALT : 2 CSL. 2127ALT : 3	All IRS B and M.G. locos	—
TY. 2.010	18	Revised tyre profiles and distance between tyres standardized.	CSL 2126 ALT : 3.	All IRS B and M.G. locos.	..

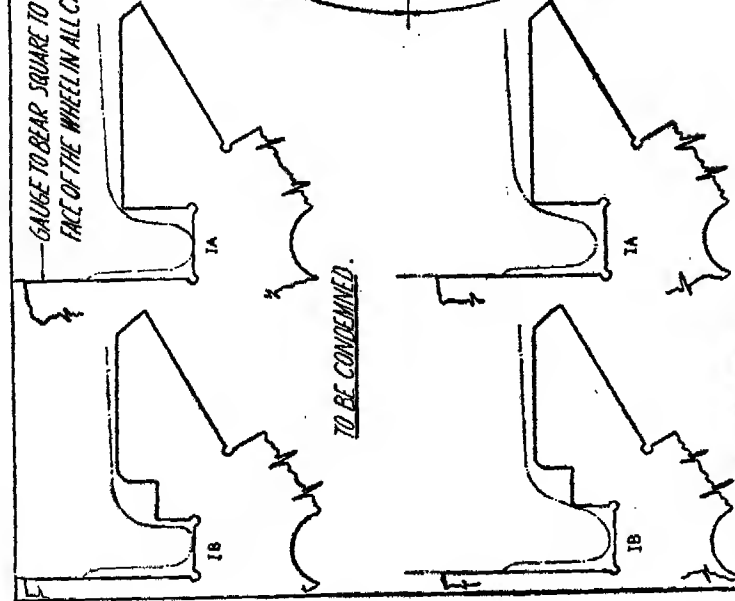


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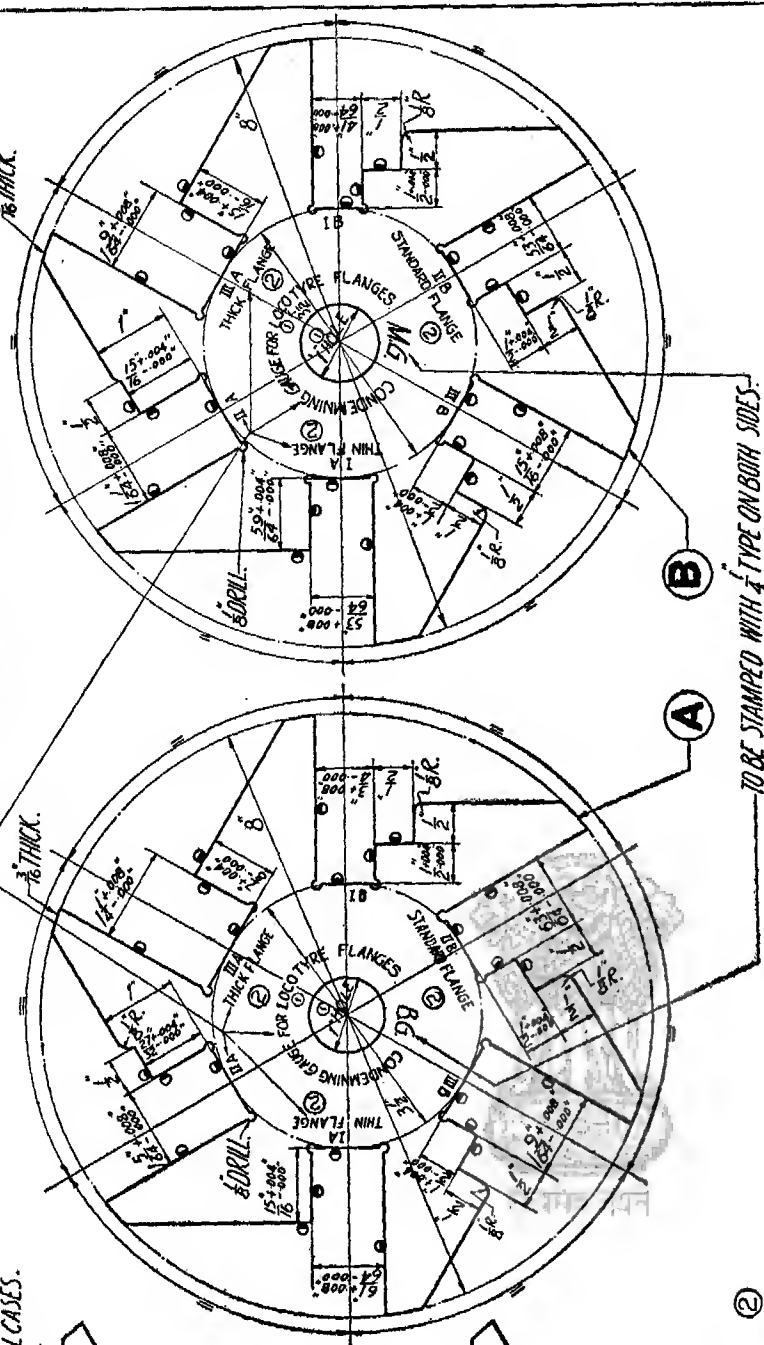
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GAUGE TO BEAR SQUARE TO THIS
FACE OF THE WHEEL IN ALL CASES.



- NOTES:
1. SET OF GAUGES 1A & 1B IS FOR THIN FLANGES.
 2. SET OF GAUGES 2A & 2B IS FOR STANDARD FLANGES.
 3. SET OF GAUGES 3A & 3B IS FOR THICK FLANGES.
 4. FLANGES ARE TO BE GAUGED WITH BOTH GAUGES A & B OF A SET & EITHER OF THEM CAN CONDEMN A FLANGE.
 5. FOR CONDEMNING A FLANGE THE BASE OF THE RESPECTIVE GAUGE MUST BEAR AGAINST THE TIP OF THE FLANGE WHEN THE LONG EDGE OF GAUGE IS SQUARELY ENGAGED WITH THE INNER FACE OF THE TYRE. (REFER ILLUSTRATIONS)
 6. THIS GAUGE IS APPLICABLE TO BIG & M.G. TYRE FLANGES, SHOWN ON C.S.L. DRG. No. 2126.
 7. FINISH MACHINED ALL OVER, EXCEPT WHERE OTHERWISE SHOWN.
 8. THIS DRG. SUPERSEDES C.S.O. SKETCH NO. L-165.

TO BE STAMPED WITH 1/4 TYPE ON BOTH SIDES.



TO BE STAMPED WITH 1/4 TYPE ON BOTH SIDES.

B.	CONDENNING GAUGE FOR M.G. TYRE FLANGES	—	ST 70 IPS M.3.CLI.
A.	CONDENNING GAUGE FOR B.G. TYRE FLANGES	—	ST 70 IPS M.3.CLI.
REF. LETT.	DESCRIPTION	PERENG.	MTL. & SPEC.

RET - C.S.L. Dwg. Nos. 2126 & 2127.
PART 4 OF XXXIII LSC.

12/56	WT. & DRG. WHEELS, "LOG. & TRG. WHEELS" & CARRYING WHEELS "DELETED."
14-2-55	REF. C.S.L. DRG. Nos. 2126 & 2127.
DATE.	PARA 4 OF XXXIII LSC.

CONDEMNING GAUGE FOR LOCO TYRE FLANGES.

C. S. L. DRG. No. 2222

B. & M. G.

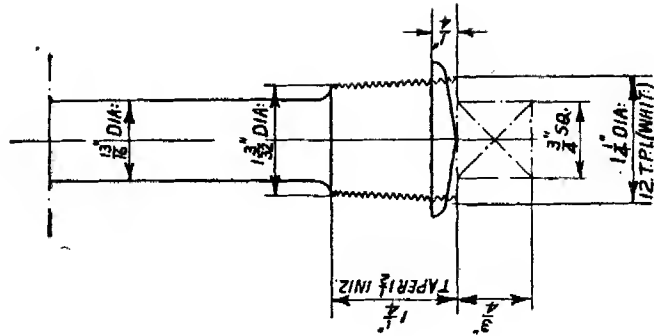
J.S. L-563
D. 4/10
T. H.M. 1/10
C. 1/10

STAY HEADS AS FITTED ON
7000 & 8000 SERIES M/CWD LOCOS:

STAY HEADS AS FITTED ON
8000 CWD LOCOS:

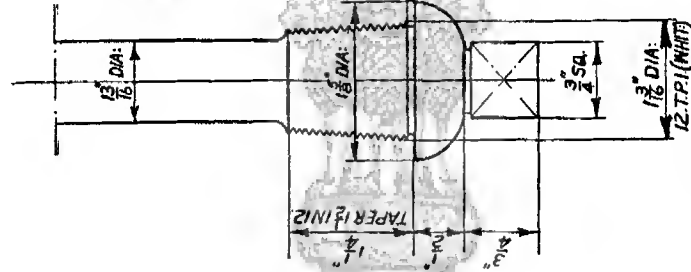
STAY HEADS AS FITTED ON
WB LOCOS BUILT BY M/S
HITACHI LTD., JAPAN; DRG:
NO: 6 WG/23.

STAY HEADS AS FITTED ON
XB BOILERS BUILT BY M/S
HENSCHEL & SOHN; DRG NO B/XB/118



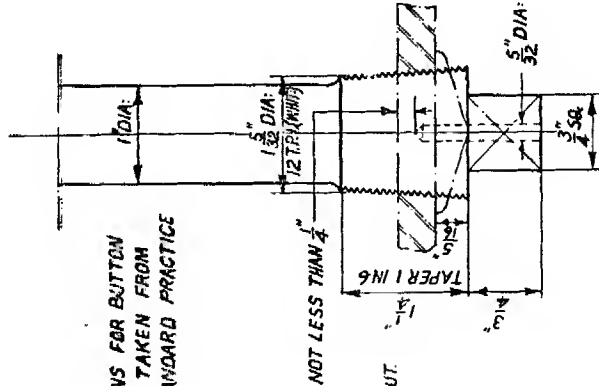
AREA UNDER SHEAR=0.3772 SQ. IN.

FIG. A.



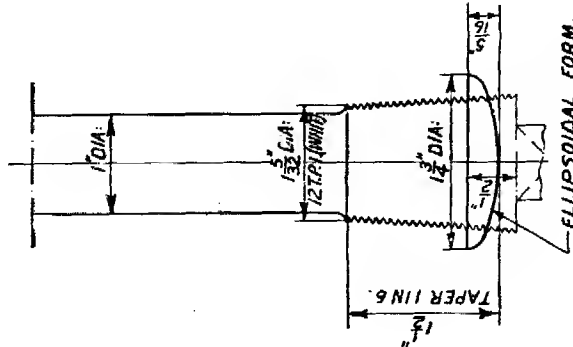
AREA UNDER SHEAR=1.509 SQ. IN.

FIG. B.



AREA UNDER SHEAR=0.6448 SQ. IN.

FIG. C.



AREA UNDER SHEAR=0.7736 SQ. IN.

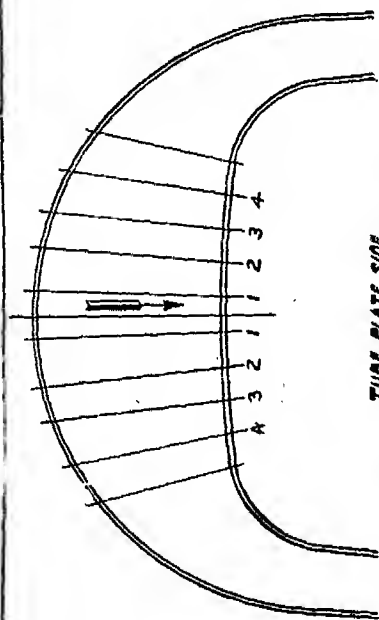
FIG. D.

TYPES OF TAPER ENDED RIGID CROWN STAY HEADS AT FIRE-BOX END.

C.S.O.SKETCH No L-464.

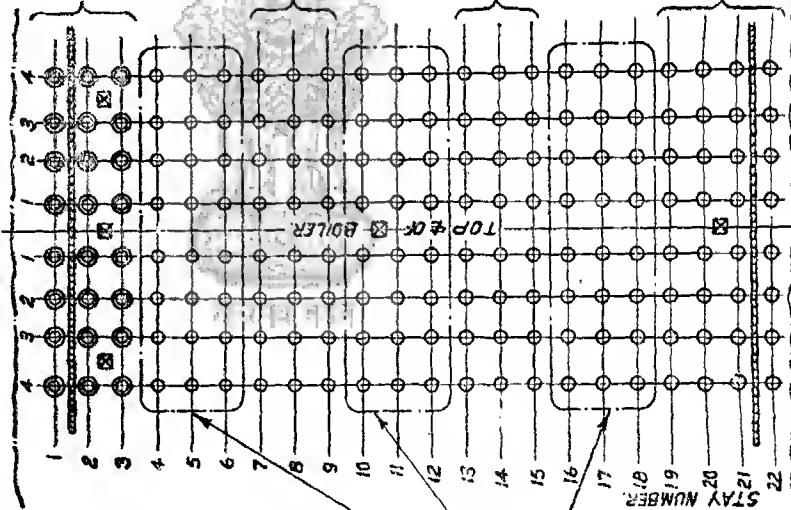
REF. (L.F.T.)	DESCRIPTION.	NO. DWS.	INTL. SPEC. NO.
	DES. DRG. NO. B/2397/18.142 5-443580(Q)		
	ITEM-4		
	8-WG/23, B.L.W. STANDARD PRACTICE SHEET-T-H-3C.		
	XXXVIII (L.S.C.) & DRG. NO. E/12885, BIXB/118.		

ACT. LEET.	AUTH.	DESCRIPTION.	DATE



TUBE PLATE SIDE

- FLEXIBLE STAYS SHOWN THUS
- RIGID SOLID STAYS SHOWN THUS
- FUSIBLE PLUGS SHOWN THUS



LEFT HAND SIDE

RIGHT HAND SIDE

TAPER ENDED STAYS TO FIG. A.
OF C.S.O. SK. NO. L-464.

VIEW IN THE DIRECTION OF ARROW

BUTTON HEADED STAYS TO
FIG. 'B' OF C.S.O. SK. NO. L-464

BACK PLATE SIDE

REF. LEFT	DESCRIPTION	QUANTITY & SPEC.
	REFERENCE - ITEM - 4 OF XXXVII L.S.C.	

ALT.	LETR.	AUTH.	DESCRIPTION	DATE
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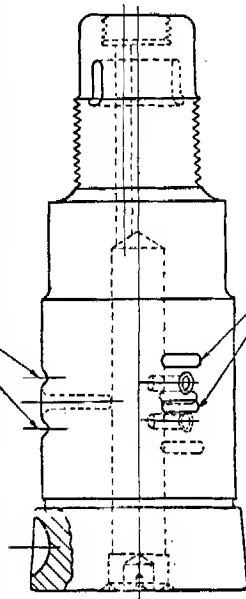
C.S.O. SKETCH No L-469.

LOCATION OF TAPER THREADED ORDINARY & BUTTON HEADED CROWN STAYS
ON 8000 SERIES CND BOILERS.

B.G.

38	0	1	2	3
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STRESS-RELIEVING GROOVE

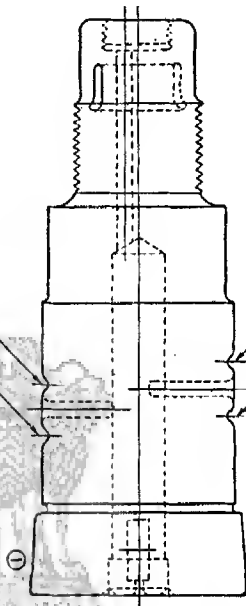


STRESS-RELIEVING GROOVE.

FOR EXISTING PINS.

SKETCH NO. 2.

STRESS-RELIEVING GROOVE.



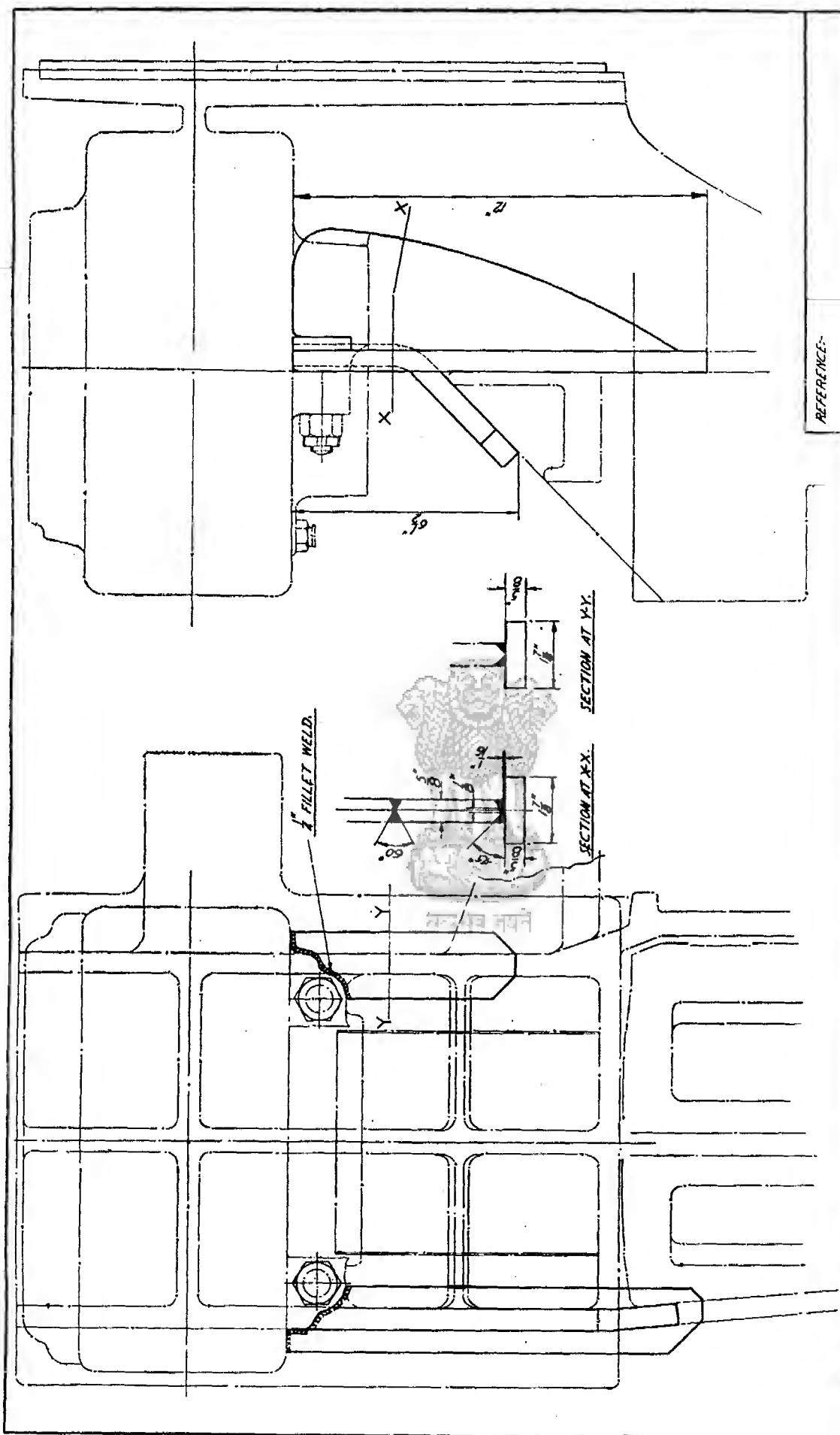
STRESS-RELIEVING GROOVE.

FOR NEW PINS.

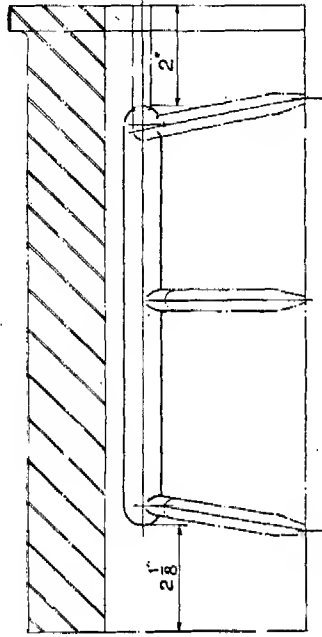
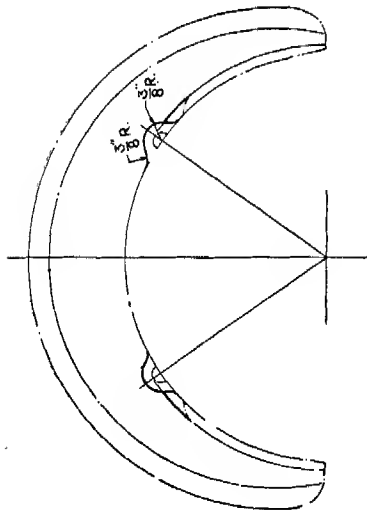
[illegible]

25.	
D.	W.H.
T.	Blended
C.	W.H.

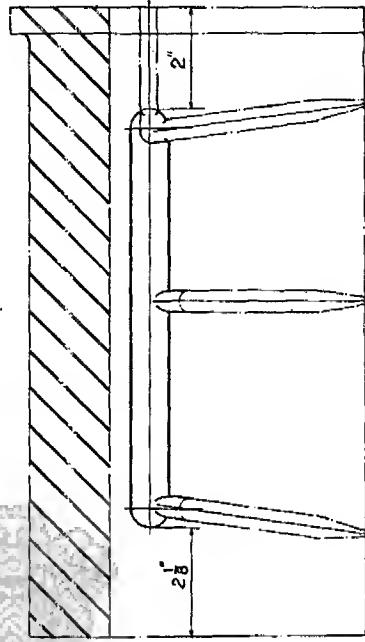
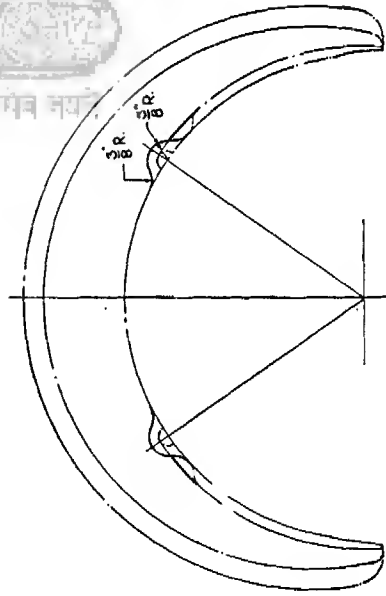
2 M. of Rly (R.B.)/58



REFERENCE:-	
B.G.	PROPOSED MODIFICATION TO STRENGTHEN THE RIBS OF SKEFFO FRONT TRUCK AXLEBOX FOR W.G. LOCOS.
C.S.O. SKETCH NO. L-511	



BEARING (LDG. INT. & TRG.)



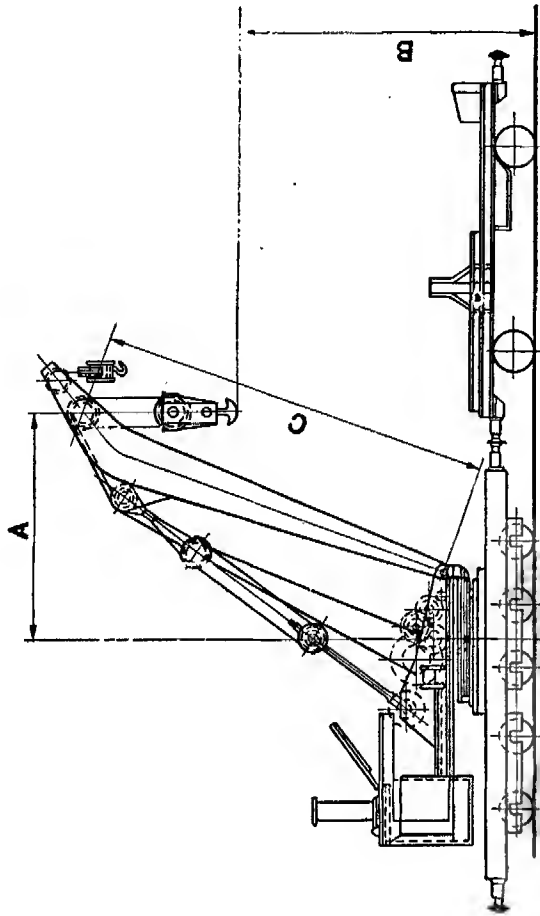
BEARING (DRIVING)

REFERENCE - L/AB-640 & L/AB-641.

35	
D.	
T.	
C.	

BG. PROPOSED GREASE GROOVE ARRANGEMENT IN COMPOSITE AXLEBOX BEARING - "WG" / "WP" LOCOS.

C.S.O. SKETCH Nº L-514.



MAXIMUM MOVING
DIMENSIONS AS PER
STANDARD SCHEDULE
OF DIMENSIONS.

B.G. CRANE TO BE CAPABLE OF LIFTING A WAGON
ON THE SAME TRACK WEIGHING 14 TONS, AT 14'-0"
BEYOND THE BUFFER FACE OF THE CRANE.
M.G. CRANE TO BE CAPABLE OF LIFTING A WAGON
ON THE SAME TRACK, WEIGHING 8 TONS AT 14'-0"
BEYOND THE BUFFER FACE OF THE CRANE.

B.G.
(5'-6')

M.G.
(3'-3 3/8')

N.G.
(2'-6')

REF. No.	MAX. LIFTING CAPACITY		RANGE OF LIFT 'B'	JIB LENGTH 'C'	WORKING AXLE LOAD PRESSURE IN RUNNING ORDER LBS/SQ. (MAX.)
	MAIN HOOK TONS	AUX. HOOK TONS			
1	75	15	33 APPROX	40 APPROX	120 16 TONS
2	40	-	25 "	32 "	" "

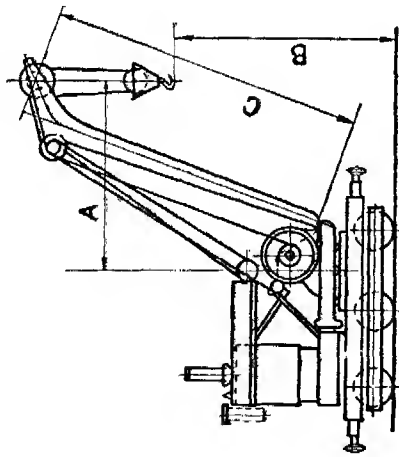
REF. No.	MAX. LIFTING CAPACITY		RANGE OF LIFT 'B'	JIB LENGTH 'C'	WORKING AXLE LOAD PRESSURE IN RUNNING ORDER LBS/SQ. (MAX.)
	MAIN HOOK TONS	AUX. HOOK TONS			
1	35	5	25 APPROX	32 APPROX	120 10 TONS

REF. No.	MAX. LIFTING CAPACITY		RANGE OF LIFT 'B'	JIB LENGTH 'C'	WORKING AXLE LOAD PRESSURE IN RUNNING ORDER LBS/SQ. (MAX.)
	MAIN HOOK TONS	AUX. HOOK TONS			

RTG. 008
R.T. 100-110-120
P
C
T
D
J5/MS113

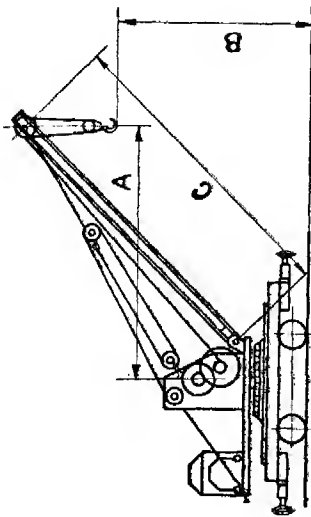
DIAGRAM OF STEAM BREAK-DOWN JIB CRANE

SKETCH No: 5120.



TRAVELLING JIB CRANE
STEAM DRIVEN

(STEAM COAL CRANE IS SIMILAR
TO ABOVE BUT HAS A FIXED JIB)



TRAVELLING JIB CRANE
HAND DRIVEN



B.G.
(5-6)

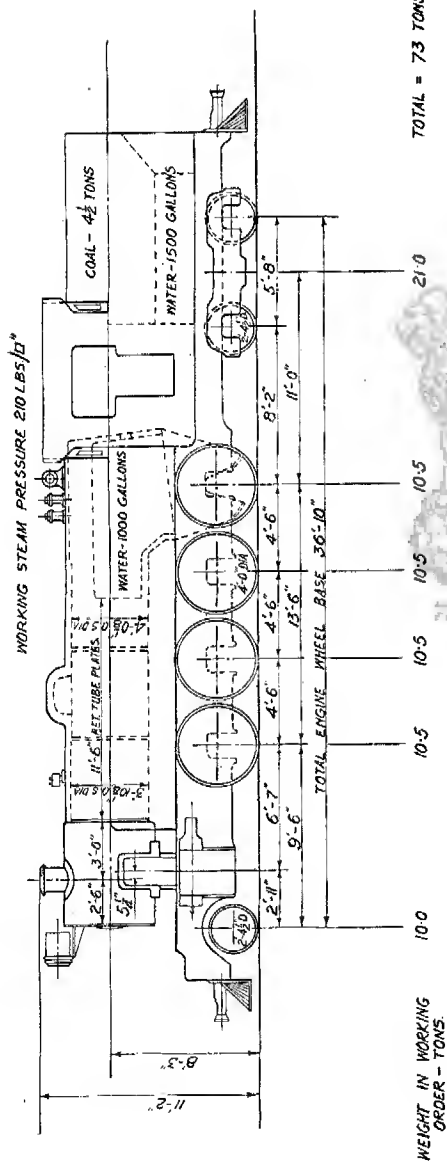
M.G.
(3-3 3/8)

N.G.
(2-6)

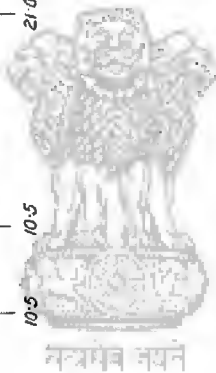
REF. NO	TYPE	WORKED SYSTEM OR HAND	MAX. LIFTING CAPACITY TONS	RATED RADIUS A'	RANGE OF LIFT B'	JIB LENGTH C'	WORKING PRESSURE LOAD IN LBS. SQ. IN. ORDER OF STEAM (MAX.)
1	TRAVELLING	STEAM	20	18'-0"	23'	30'	120
2			15	18'-0"	23'	30'	"
3			10	16'-0"	19'	26'	"
4			5	16'-0"	15'	22'	"
5			10	16'-0"	19'	26'	"
6			5	16'-0"	15'	22'	"
7			3	16'-0"	15'	22'	"
8	COAL	STEAM	2	24'-0"	19'	26'	120

DIAGRAM OF STEAM & HAND OPERATED TRAVELLING JIB CRANES & STEAM COAL CRANES

SKETCH NO 5121



TOTAL = 73 TONS.



CYLINDERS (2) OUTSIDE.	DIA X STROKE	14 1/2" X 22"
DIAMETER OF COUPLED WHEELS		4'-0"
TRACTIVE EFFORT AT 85% BOILER PRESSURE	185	19,000
FACTOR OF ADHESION IN W.O.		5.20
FACTOR OF ADHESION IN EMPTY CONDITION		4.34
LEAD		7/32"
LAP		1 1/8"

LD/SK. No. 79

LOAD-SPEED GRADIENT CHART

PROPOSED 2-8-4 TYPE TANK LOCO - M.G.
(FOR HEAVY SHUNTING & SHUTTLE SERVICE)

GRADIENT - PERCENT

2.5

2.0

1.5

1.0

0.5

0

0

10

20

30

40

50

SPEED IN M.P.H.

1400 TONS
1700 TONS

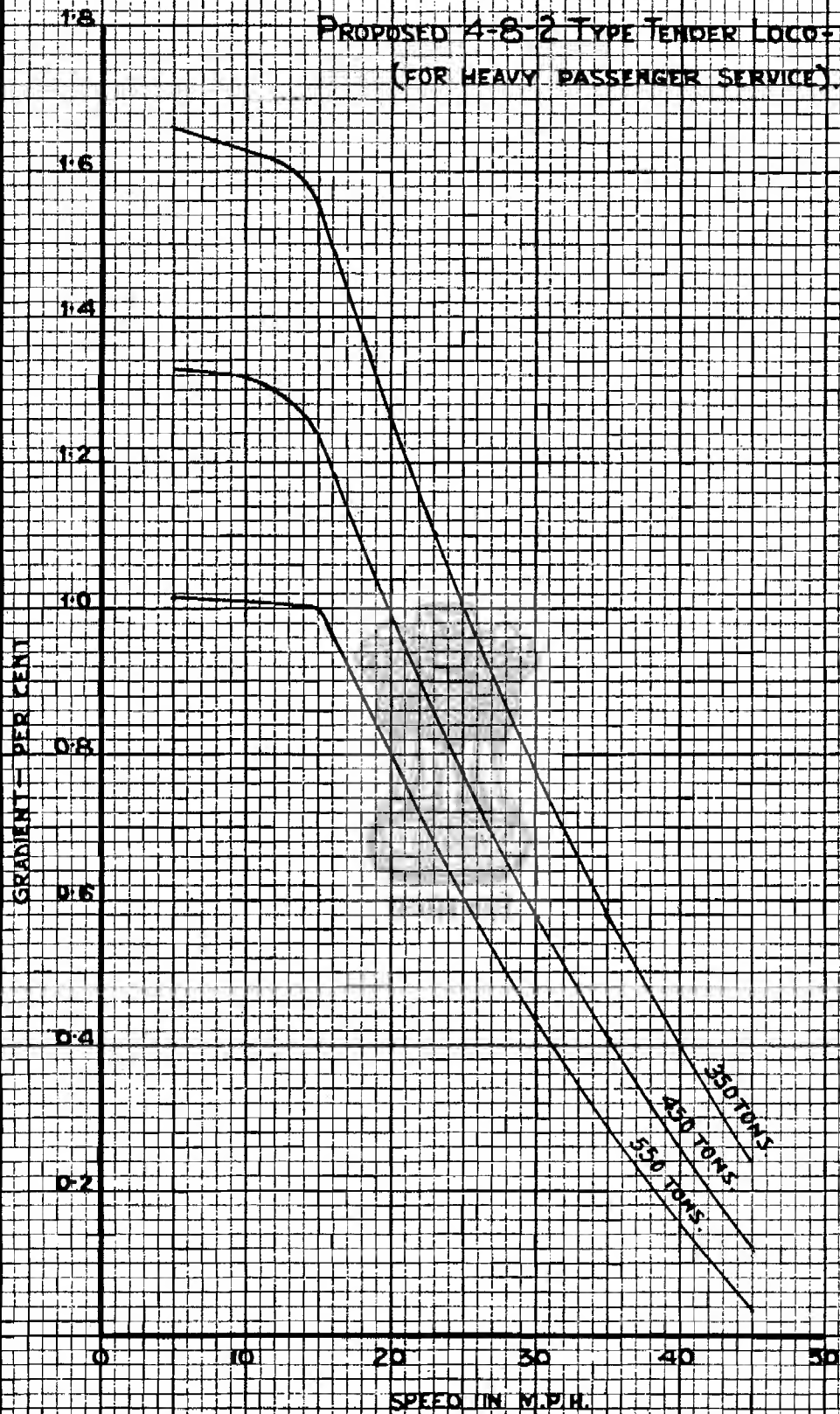
700 TONS

240 TONS
360 TONS
480 TONS

LD/G-211

LOAD-SPEED GRADIENT CHART

PROPOSED 4-8-2 TYPE TENDER LOCO-M.G.
(FOR HEAVY PASSENGER SERVICE).



LD/G-212

